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VOL. XXIX.
No 730.

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NOVEMBER 20, 1891.

[Registered at G.P.O. as a Newspaper.]

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW

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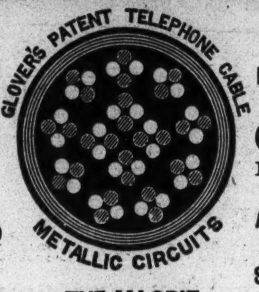

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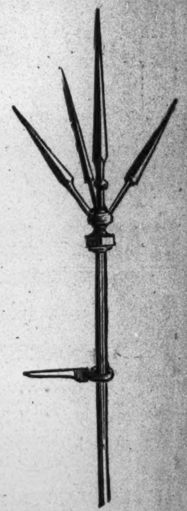

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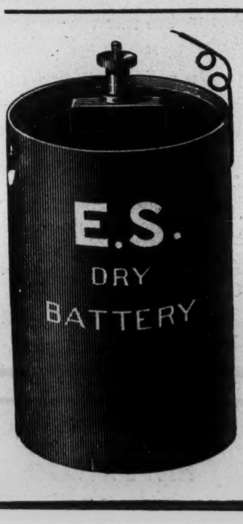

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RESEARCHES ON THE CONDUCTIVITY OF SOLID ELECTROLYTES.

THE influence of temperature upon the conductivity of electrolytes forms an interesting field of research in which there is still plenty of room for work, owing to the experimental difficulties that have to be contended with, and the character of the results that have hitherto been obtained. This statement is especially true of solid electrolytes, in the case of which no exact quantitative determinations have been made, owing to the uncertainty involved in imperfect contact of the electrolyte with the metallic part of the circuit.

The changes in the electrical conductivity of solid electrolytes due to rise of temperature have recently been placed under investigation by J. Rosenthal, who used the well-known method of Kohlrausch, making, at temperatures below 100° Centigrade, the contact with mercury, and above this temperature employing Rose's fusible alloy.

A considerable number of substances was examined in this research, and the results are given in upwards of 20 pages in the *Ann. Phys. Chem.*, series 2, Vol. xliii., p. 700, but these determinations of the electrical conductivity have only a relative value, because Rosenthal was unable to overcome the difficulty of making perfect contact between the electrolyte and the metallic part of the circuit. It appears, however, that the conductivity of the substances which *were* placed under examination increases as their temperature rises.

We may note a few of the results which seem of special interest. For example, when lead chromate was maintained for some time at a high and constant temperature, without allowing it to become plastic or liquid, it exhibited a conductivity which *diminished* in proportion to the time of exposure, but the rate of this diminution became greater as the temperature rose.

The curious fact was observed that some substances conduct better at any definite temperature if they have been previously exposed to a higher temperature; the chloride, bromide and oxide of lead are examples of this. These substances are all very plastic below their melting points, and this fact is interpreted by Rosenthal as explaining why the melting point is not a singular point in the curve of electrical conductivity, as L. Graetz observed in a large number of instances.

The experiments of Rosenthal also show that the electrical conductivity of a solid electrolyte depends to a very considerable extent on the state of aggregation which it is in; for example, lead chloride which had been precipitated and compressed had a much greater resistance than the same substance when fused, powdered, and then compressed. With this should be compared the previous observation respecting the increased conductivity at any definite temperature shown by certain lead compounds when they have been once heated to a higher temperature.

In connection with these results it may be interesting to read a paper by Graetz in Vol. xl., series 2, pp. 18—35, of *Ann. Phys. Chem.*, on the electrical conductivity of fused and solid salts. Here tables are given for the following substances, namely, the chlorides, bromides, and iodides of cadmium and zinc, lead chloride, lead iodide, potassium nitrate, cuprous chloride, stannous chloride, and antimonious chloride. Graetz also discusses at some length the theoretical aspect of the subject, particularly in its bearing upon dissociation.

ELECTRICAL MEASURING INSTRUMENTS.

THE Institution of Electrical Engineers cannot be greatly congratulated, on resuming its sittings, on the reading of the paper which was presented at the meeting held last Thursday. One would opine that the Council found itself in a difficulty, which has before presented itself, in the way of a dearth of papers, and consequently had to accept anything which came to hand. The paper contains an apology for bringing forward matter devoid of originality, and it amply fulfils its own criticism. As read, it was much "padded" with tables of various constants, &c., referring only to the actual instruments described, and hence of no possible general interest.

The methods and instruments mentioned in the paper have long been known as among the very best ones for arriving at accurate measurements under the conditions of varying fields, &c., found in workshops, and have been employed for some considerable time past in a well-known West End Technical College; this is true even to such details as the employment of large platinoid strips and mercury rheostats. We do not suppose for an instant that the authors merely copied these already existing instruments, but the fact that they have been there employed remains. It would have been well for the authors to have gone carefully into the matter of the D'Arsonval galvanometer, and they would doubtless have arrived at what is quite an easy matter to secure, namely, a D'Arsonval in which the deviation from straight line law is barely, if at all, perceptible; they would then, also, not have put up instruments requiring to be "turned round on their bases" to set to zero.

It is interesting to note that it has been thought worth while by an engine manufacturer to put in an expensive and complete set of apparatus merely for the purpose of accurately measuring the output of dynamos supplied to him, and of his own engines. Many a purely electrical firm concerned in the actual making and calibrating of instruments is content to go on using dynamometers and other instruments in which the range of fair accuracy is much restricted, and that without providing any of the means set forth in the paper for testing the constancy of their standards except on very rare occasions. It is mentioned in the paper that the constants varied one-fifth per cent. in six months; it should be quite possible to get D'Arsonvals, which do not show one-half that alteration in a year.

There can be no doubt that the D'Arsonval method of measuring the fundamental electrical quantities is the best and most accurate for purposes of this kind; its advantages will no doubt be more appreciated and enhanced in the future, especially if the new manganese bronze (which is said to have a very small *negative* temperature coefficient) should turn out to be as good as one hopes for.

THE "HEALTHINESS" OF THE ELECTRIC LIGHT.

THE statement that the general health of the staff employed in the Central Telegraph Offices has exhibited decided improvement since the adoption of electric lighting can be readily believed. Any light secured by burning gas or oil not only minimises the proportion of oxygen in a room, but speedily increases the proportion of carbonic acid present. The significance of this is seen when we consider the constitution of atmospheric air and the products arising from the combustion of inflammable substances as well as from the life-processes of animals.

Air is normally a mechanical mixture of two gases, oxygen and nitrogen; these are present in the proportion of about 20·9 volumes of the former to 79·1 of the latter. Oxygen is the important constituent, the nitrogen being an inactive gas which merely serves to suitably dilute the oxygen.

Although the composition of the oxygen is marvellously constant, yet the air in confined spaces may become rapidly modified by various agencies, chief amongst which are combustion and the respiration of animals. This deterioration is compensated by the power possessed by plants of decomposing carbonic acid, whereby they split it up, retaining the carbon and restoring the oxygen to the air. But, obviously, in confined spaces, such as in rooms and buildings, this compensation by plant-energy cannot go on, hence elaborate systems of ventilation are employed, none of which, however, can really cope successfully with the difficulty without introducing the disadvantages of draught.

Now animals, or, to particularise, human beings, must have a plentiful supply of oxygen for their respiration, and gas or oil flames must have a large supply of it also for their combustion, but the electric light requires no oxygen. Again, human beings suffer in health if they have to breathe an atmosphere laden with their own respiratory excreta plus the fumes arising from the combustion of oil or gas. How much better, therefore, to employ a source of light that does not depreciate the quality of the air. Such a light is that supplied by electricity, and it is marvellous, that in these days of scientific sanitation, those who are responsible for the public health do not insist upon the illumination of all public buildings with a light which does not vitiate the atmosphere.

If we were to prepare an indictment of gas and oil we should require a great many columns of the ELECTRICAL REVIEW, and it would be necessary to consider not merely the carbonic acid arising from their combustion, but also the numerous other products which are given off, many of which exert a much more baneful action upon the human economy than does carbonic acid. But what can be a stronger object lesson than that obtained from a study of the improved health of the staff employed in the Central Telegraph Offices since the introduction of electric lighting?

Steam Power and the Coal Bill.

IN central stations for electric lighting, no single item of expenditure can compare with the amount disbursed for fuel. It is therefore incumbent on the engineer in charge to exert his utmost endeavours to minimise the consumption of coal by every means in his power; boilers, engines, and steam pipes, &c., must be kept in the most perfect order, so that the losses by leakage or friction may be reduced to the lowest possible proportion. As Mr. Thomas Pray, jun., writes, in the new engineering periodical, *Cassier's Magazine*, the amount of coal used is dependent on many and varying conditions. How to burn it closely and clearly is to a great extent governed by the apparatus furnished, and when the plant is once in place and in operation, the most must be made of the apparent conditions. There are occasions when the coal bill may seem high and yet the engineer may be unable at first to discover where the fault lies. An instance is given of tests recently made of two engines. The first was an ordinary link motion engine, A, the other a Corliss engine of the most economical modern type, B. The computations from the diagrams showed that A required 40·2 pounds of steam per horse-power hour, and B 39·2 pounds, or a difference of only 2½ per cent. between the efficiency in commercial use of the extremes of good and bad practice as generally allowed. There was good reason for this; A was in perfect order, while B was leaking badly after the valve was supposed to be closed, so that either a large amount of steam entered the cylinder which did not do work with economy, and after the valve had made the motion of closing and had commenced the expansion, a large amount of steam entered the cylinder, thus practically converting the supposed cut-off engine into a nearly non-expansive one during the latter part of the stroke; thus during the last half of the stroke more was lost than was gained in the first half. The apparent diagram was good looking and the leakage had escaped the notice of the engineer in charge for a long time, with the consequent loss of some 40 per cent. of work for the same consumption of steam. Mr. Pray promises a future article, with illustrations and general deductions for those who are interested in the economical use of steam power.

Gutta-percha Insulation.

EVER since the introduction by the late Mr. Willoughby Smith of a process by which the specific inductive capacity of gutta-percha could be brought down to a low value, manufacturers have vied with each other in attempting to still further reduce the capacity, and this they have done chiefly by the process of mastication. It is questionable whether in effecting their object the manufacturers have not in many cases made a very great mistake—a mistake which has been fostered by a want of consideration on the part of those who specify for the material. Low capacity is of course of importance where long cables are concerned, but in cases of short cables, where the speed at which the clerks can manipulate the signalling apparatus is far below the theoretical speed, the question of capacity is of very little account, and it might almost be advisable to specify that the capacity should not be *less* rather than not *above* a certain standard. It appears to us that the mastication process as now carried out literally takes all the life out of the material. Provided the impurities in the shape of grains of woody material and free water are eliminated, the gutta-percha had much better be left in its primitive state with its natural essential oils and combined water left in it, instead of having the latter carefully driven out, with the result that the durability of the material is in many cases fatally reduced. This is especially the case where the insulated wire is used for underground or aerial purposes. Of course we are alive to the fact that for underground purposes when fast working is aimed at, low capacity is of great value, but where it is obtained at the expense, as it is, of durability, it is dearly earned. It would, we think, be far better to obtain low capacity by an extra thickness of material, as the greater expense of the same would be well repaid in the end.

The Heat Generated by the Union of Ions.

SOME time ago Arrhenius was led by his researches to express the opinion that the heat generated by the union of the ions of a salt is either very small in amount, or, in some cases, even negative. The same conclusion has recently been arrived at by J. D. Van der Waals, who approached the question from a different point of view, namely, by examining the formulæ for electrolytic dissociation. This result is explained by Van der Waals, by making the assumption that between the ions and the liquid, in which the salt is dissolved, there is a very great attraction, and that this attraction is even greater in some cases than that which exists between the ions themselves. The paper in which this work is fully discussed may be consulted in the *Zeitschrift für Physikalische Chemie*, Vol. viii., pp. 215—222.

The Dangers of Large Flywheels.

IN a recent issue of the *Scientific American*, instances are given of the dangers of large flywheels. The breaking of a large 68-ton flywheel at Amoskeag Mills, Manchester, N.H., had a fatal result, and at the subsequent enquiry it was pointed out that the remnants of the flywheel showed many internal flaws which it was impossible to discover when the wheel was intact. A similar accident occurred in the engine room of the Electric Street Railway Company, Cincinatti—a wheel of 20 tons suddenly breaking. In neither of the foregoing cases were the wheels travelling above their normal speed, and it would appear as though the flaws had gradually become chronic through incessant running. There seems to be no means of safeguarding against these accidents, beyond the prevention of keeping wheels away from crowded workrooms, for in a recent enquiry among American makers, not one knew of a method of discovering the presence of flaws, the result of air-bubbles in moulding or improper cooling. It is left to a future inventor to devise some means, electrical or otherwise, of properly diagnosing faulty wheels, and manufacturers will hail with pleasure the advent of such a discovery.

Magnetic Reluctance.

MR. A. E. KENNELLY has long been known for the originality of his work, and we have to chronicle a further addition to our magnetic knowledge which is due to him; it was first published in a paper read before the American Institute of Electrical Engineers, on October 27th. The phenomenon of the magnetisation of iron can be represented by various curves between the quantities B, H and μ, and these have universally been employed in all modern researches. Mr. Kennelly has applied the idea of *reluctivity* (or specific magnetic reluctance, to use a somewhat ambiguous phrase,) to give us a new curve, namely, that connecting the reluctivity, , with the magnetising force, H. These (H, ρ) curves are highly remarkable in appearance. The (H, μ) curve is well known, and after the critical point it falls in a very nearly hyperbolic fashion; we should hence expect the (H, ρ) line to be nearly straight after that point, and, as a matter of fact, it is quite straight within very wide limits of magnetising force. The first part of the curve is not linear, which is what one would expect, as the value of μ is nearly constant for small values of H. Mr. Kennelly points out that his results give a sort of physical support to the well-known Frölich formula. He also strongly supports the application of Ohm's law to magnetic circuits, urging that as we speak of the increase of resistance to high period alternating currents, which increase is a function of the period, we are just as right in saying that when an iron circuit contains iron, its resistance is a function of the magnetising force.

Annual Dinner of the Institution of Electrical Engineers.

"THE third annual dinner of electricians," said someone who ought to know, "was anything but *electric*." We had the utmost difficulty in persuading several Americans present on Friday evening, that Englishmen really can be cheerful at times, after dinner, and that on this occasion exceptional circumstances had cast a gloom upon the majority of the diners at the Criterion. In the first place the Coldstream guards played anything but lively tunes, which depressed the spirits of many who, as a rule, take no heed of Fridays or the 13th of the month. The eatables were not as good as the occasion should warrant, and the service generally was inferior to that of a city restaurant. These unfortunate circumstances produced a more or less melancholy effect upon the distinguished assembly of electrical engineers, which effect was faithfully reflected in the sleepy, aimless and pointless speeches following the dreary feast. Cabinet ministers, who adorned the first and the second annual dinner, held aloof this year, but this fact alone ought not to have been responsible for such a "sad-eyed" failure.

Economic Limits of Large Power Units.

IN the *Electrical Engineer*, of New York, of November 4th, will be found an interesting article on the "Economic Limits of large Power Units," in which the author (who is said to be a man of large experience in steam engineering) gives his views on the question of the best distribution of power in a central station. It is rather remarkable that he should favour the English method of direct driving by high speed engines, rather than the belt driving system so generally in vogue in America. At the same time, he views with disfavour the use of compound non-condensing engines, and rather inclines to the direct acting non-condensing form for central station units of ordinary size. This advice coming from an American to Americans has considerable significance, and is especially encouraging to English engineers.

Horse-power Diagrams.

IN the same journal appears a useful little diagram giving the H.P. required to run at any speed up to 25 miles per hour with loads up to 20 tons, on both the level and up inclines. It consists of two pencils of rays from the origin; the first gives the relation of weight to H.P. for various speeds, assuming a traction coefficient of 30 lbs. per ton; the second gives the relation between H.P. on level to H.P. on various slopes up to 6 per cent. grade. By means of these it is very easy to read off the H.P. for any ordinary speed and gradient, and the diagram should prove of considerable utility to traction engineers as a means of saving time in small calculations.

Electricity in the Brewery.

IN our issue for November 13th under the heading "Electricity and yeast culture," we noticed some observations by our contemporary, the *Brewer's Journal*, upon the advantages of using the electric light in the fermenting rooms of breweries. The current issue of this enterprising trade organ has some further remarks on the same subject. During the cold weather, and generally throughout the winter, brewers naturally have to close up some of their departments in order to be able to maintain the proper temperature in them. In closing the various rooms they necessarily darken them, so that during day and night some artificial light must be kept constantly burning. Gas is most commonly employed. This practice, however, cannot possibly facilitate purity of the atmosphere. In view of the connection between pure air and young yeast, and of the fact that brewers have latterly found it necessary to allow their yeast out-crops to mature upon the surface of fermenting beer, particular attention ought to be paid to the nature of the artificial light employed. "And for this reason," says the *Brewer's Journal*, "we have always favoured electric lighting. We are far behind Continental competitors in this respect, and while it may not be desirable to adopt their particular method of beer production, we can, at any rate, do much to improve our own process by giving attention to fresh suggestions of real practical value." Now, no one needs to be told that in the great brewing industry of this country there is a vast amount of capital employed, and we know, too, that amongst the ranks of brewers there is a particularly large proportion of intelligent and scientific men, for such is the nature of brewing nowadays that a good brewer must be scientific. Hence, therefore, there should be a fine field awaiting those electrical engineers who will make the requirements of breweries a speciality; and what better clients could anyone wish to deal with than with capitalists who are both intelligent and enterprising?

Motor Troubles.

MESSRS. CROCKER & WHEELER have recently been publishing a set of practical hints as to the cure of various troubles which arise with motors and dynamos. Some time ago Prof. Silvanus Thompson read a paper before the Old Students' Association on a similar subject, but since then nothing has been published dealing with the matter. The articles in question are intended for the use of men in charge of machines who are not possessed of very special knowledges, and they are exceedingly well arranged and well to the point. It would be well to have them printed in pamphlet or rule form, and have them hung up in all central stations.

A Novel Method of Protecting Iron Surfaces from Rust.

IN a new process which has recently been worked out by Mons. P. Henry Bertrand, of Paris, and which has for its object the protection of iron surfaces from rust, the important feature is the formation of magnetic iron oxide. A metallic film is deposited by one of the galvanoplastic methods upon the surface of the iron, the deposit being capable of volatilisation at a high temperature. This deposited film performs the function of partially protecting the surface of the iron from oxidation. When the temperature has, however, reached a certain point, oxidation does set in, but instead of the sesquioxide being formed, namely, Fe_2O_3, the magnetic oxide, Fe_3O_4 is produced. During the exposure to heat, the deposited film becomes volatilised, and it is stated that in four or five minutes the magnetic oxide completely covers the surface that is under treatment. Surfaces of iron thus covered with a thin layer of the black magnetic oxide will, as far as experiments show, be perfectly protected from rust, that is from the formation of the red oxide, for any length of time. Particulars of the method and of the materials used are not at hand; we presume, however, that the latter are to be purchased from those who are exploiting this invention. If it should really prove to work well, it promises to be of some considerable importance in protecting iron-work that is exposed to the corroding action of moist air.

The Velocity of Electricity.

PROF. J. STYAN has been at work upon this subject recently, and has been endeavouring to throw further light upon it. He employed Hertz's now well-known method of producing stationary waves in wires using a circuit similar to that used by Wheatstone, but made on a smaller scale. This circuit was connected up with two long straight wires, and the length of the wave in the circuit was compared with the length of the same wave in the straight wires. He observed that the length of this wave was much longer in the circuit, and hence he deduces that the velocity of electricity in the circuit is greater than in the straight wires, exceeding it by a ratio which is greater than that found by Wheatstone.

THE AMERICAN STREET RAILWAY ASSOCIATION.—CONVENTION AT PITTSBURG.

IT was in the month of February, 1888, that we last visited Pittsburg. The National Electric Light Association held its meeting there, and one of the many treats provided for us was a visit to the new electric railway, which had just been constructed by Mr. R. W. Blackwell. The line, which was provided partly with underground conductors (conduits) and partly with overhead conductors, had not been quite finished, but Mr. Blackwell was anxious to show us his good work and run the cars for our benefit. Electric railways were few and far between in those days, and we thoroughly appreciated Mr. Blackwell's undertaking, sympathising with him, as we always have when meeting pioneers of electric traction. Since that time over 400 electric railways have been built in the United States, involving a capital expenditure of about £15,000,000. "We old dogs," said the president of the convention of the Street Railway Association, held at Pittsburg last month, "have been obliged to learn new tricks, and without the usual privilege of serving an apprenticeship. Our stables are being converted into power houses, the electrician has taken the place of the veterinary surgeon, our drivers are being educated as motor men, and most of us have horse cars for sale."

The following statistics have been published showing the status of tramways of every description in the United States and Canada:—

Total number of miles	... ...	11,030
Number of miles operated by	animal power ...	5,443
" " "	electricity ...	3,009
" " "	steam motors ...	1,918
" " "	cable	660
Number of cars operated by	animal power ...	25,424
" " "	electricity ...	6,732
" " "	cable	3,317
" " "	steam motors ...	1,044

It is interesting to note that since November, 1890, the number of horses employed on street railway lines has fallen from 116,795 to 88,114; that is, 28,681 in one year. At this rate it will not take long to emancipate the horse from street railway business. In concluding his able address, President Watson paid a high compliment to the technical press, particularly the street railway journals. "The development of new forms of rapid transit has sent us back to school again, and these are our text books. From title page to back cover we scan them through, advertisements and all, in our eagerness to learn the very latest advances in electric, cable, and other forms of motive power. Their digests of the important decisions of the courts, their carefully tabulated statistics, their superb illustrations, their detailed descriptions of the power plants and requirements of the most progressive street railways of the world, are all features which commend them to our heartiest support. They would do splendid missionary work in the editorial rooms of some of our leading daily papers."

Mr. H. A. Everett, of Toronto, read a paper on "A Perfect Street Railway Motor." The author, being manager of the Toronto Tramway, touched upon the question from his own standpoint, and he evidently intended to impress electricians with his ideas as to what a perfect motor "ought to be." He thought that it would be an improvement if in all machines made, a better insulation both in the armature and field wires were used. A more reliable and positive fuse, one that would always burn out when the motor was overloaded beyond its maximum capacity, would also be a great improvement. Referring to the price of electrical equipment, the author said that instead of operating 4,000 motor cars, the construction companies could equip 40,000 within a short time if they would bring the price down to a reasonable figure, so that all companies could afford to purchase equipments.

Taking the trolley wheel, pole and stand, Mr. Everett thinks it desirable to have a wheel that is capable of following the wire at any angle, with a trolley pole brittle enough to break should it become entangled in the wires, without pulling them down, and a trolley spring rigid enough to give a good steady pressure on the trolley wire, and so constructed that when the car is in the car house or going under a bridge the pole could come very close to the roof of the car; also flexible enough to give good pressure when the trolley has to be 21 or 22 feet high at railway crossings; also to have on each car the best lightning arrester that can be secured in the market. In coming to the motor proper it is desirable to use a controlling switch that is easily operated and readily reversed in case of accidents. The rheostat should also be carefully looked after and properly protected to keep it from injury by water, snow, or dirt getting upon it. It should only be employed in starting the car to avoid the jerk, and should be so arranged as to cut out as soon as the car is started, and so allow the entire efficiency of the motors being utilised.

The motor should be well protected in all its parts from any outside interference, so that in running along the street it will be impossible to pick up nails, wire, or anything that would short-circuit it, at the same time observing that a motor must be properly ventilated to keep it from heating while in use. The cover should be made so as to be easily removed. It is very desirable to have an armature of a large diameter, making a small number of revolutions per minute, with the bearings made of extreme width, with proper grease-cups. The diameter of the commutator should also be large, and have the brushes easy of access. The winding of the armature should be of the simplest kind. The insulation of wires in armatures is at present one of the weakest points in the motor.

At present, the author thinks, the single reduction motor is the nearest perfection of any in the market. It is very desirable that the electric companies should devote some time to the perfection of an electric brake to stop the car with the same power that runs it. Electric heaters are used in a number of places, and they will prove quite satisfactory. He is in favour of an oil head-light, one that can be removed easily, so that in the event of a trolley being broken or anything happening to the electric part of the car, as a light is desired underneath the car, the oil head-light can be used to better advantage than the electric.

The single reduction motor when properly looked after ought to last for many years. Mr. Everett had one in operation for over ten months, and it appears to be in as good condition as when first it went on the road. The noise of the motors has been very largely done away with, and by careful attention the gearing can be used until worn out by simply covering it with an oil box, and not running too many miles without inspection.

During the discussion of this paper Mr. Stephenson asked, How much were they going to make by the change from horse traction to electric traction, and how much are we going to lose? In the last report of the United States Census Bureau, the statistics of 50 roads were given. No roads were mentioned by name or even the cities in which they were located. There were three roads operated by cable, 36 by electricity, and the remainder by horses. The horse and cable roads were the only ones that paid dividends.

Mr. Pearson, of Boston, said he could give some information on this subject. In Boston the cost of operation is quite high as compared with some other cities. They pay 25 cents a day more for motor men and electric car conductors than they do for horse conductors and drivers. Another item of expense is the high cost of power, as they had been obliged to hire power from an electric light company and pay it a good price, of course much more than it would cost a street railway company if it had its own power house. Nevertheless the saving of electric cars, compared with the horse system, is about 25 per cent. At Boston they began with a 16-foot car, similar to the old horse cars. Now they have 26-foot cars, and find a great improvement in the earnings, and saving in operating expenses per passenger carried. The long cars earn a great deal more per mile, and have only the same number of men to operate them as the short ones. The amount of power consumed on a level track is very little more than with the old short cars.

The next paper, of Mr. Mansfield, entitled, "The Overhead or Underground System of Electric Motive Power," was also an interesting one, but it requires some comments on our part on certain untrue statements contained therein. The author states at the outset that the electric railway with underground conductors or conduits is to-day a failure, and that it cannot be made a success throughout the American cities, its fatal weakness being in the inability to prevent the conduit from becoming filled with water, mud, &c. Mr. Mansfield does not seem to be aware of the successful electric tramways at Budapest, which are worked with underground conduits in the busiest streets of that city, nor of the now historical Blackpool electric tramway. He also devotes some consideration to the "surface method," which consists of an underground insulated conductor and contact points moved by magnets upon the car as the same passes over the line.

The author enumerates several methods without mentioning the names of the respective inventors, and in summing up this portion of his subject says that it certainly looks as if we could not expect much from these systems. Much perseverance and money must be expended before as practical and certain a method as the present overhead conductor is attained. Concerning the third or overhead method, Mr. Mansfield has much to say, and in this branch he possesses certainly a large amount of knowledge. There are two general methods of operating the overhead system. One is by having a continuous trolley wire wherever the track runs, and the second is to have this trolley wire divided into sections. For towns and for suburban traffic, the former is almost invariably adopted. Practice would seem to indicate that but little trouble is experienced, and that there is practically no advantage in dividing the trolley wire into sections. In fact, there is a disadvantage, since we lose its conductive capacity. Obviously, the methods of feeding the trolley wire vary with the method of arranging the same. With the first method mentioned (using a continuous trolley wire) the feeders are either extended from the station the entire length of the route, tapping into the line at intervals, or else separate feeders are run out from the station to certain predetermined distances, and there tapped into the trolley wire. When more than one feeder wire is needed in either case, a repetition of the scheme is carried out from feeder wire to feeder wire. There is little to choose between the two methods; both are good. With the second method (the divided trolley wire) there are two ways of accomplishing the feeding. First, to extend the feeder the entire length of the line and tap into the centre of each section of the trolley wire; or, second, to extend the feeder the entire length of the line and tap into both ends of each section. The advantage of the former is that in time of trouble a man has to run to only one box to cut out a section, or the whole arrangement could be made automatic by putting a fuse or a mechanical circuit-breaker in the box. The disadvantage is that you lose the value of the trolley wire as a conducting medium, which in the case of hard drawn copper wire is considerable.

The point which Mr. Mansfield urges upon railway corporations is that they should take care that enough copper is used, for he has found in many roads that the larger part of the trouble lay in the fact that they did not have either sufficient trolley wire or track feeders. The objection to having too many wires overhead can be overcome by placing the feeders underground. He recommends for the return circuit as many earth plates as possible; the wire connecting them to the track should be of sufficient size and very solidly attached to the rails. The continuous supplementary wire should also be employed. The author sent 400 circulars with questions on the following points:—1. Trolley wire. 2. Span and guard wire. 3. Feeders. 4. Loads carried and conditions. 5. Tests. 6. Accidents. 7. Miscellaneous. He succeeded in getting answers from 137 roads, operating 1,546 miles of trolley wire and 1,657 cars. Of this number 71 were Thomson-Houston and 66 Edison and other systems In answer to the first question, out of 137 roads 99 were using copper *trolley wires*, 28 silicon bronze wire, 8 were using both, and two preferred phosphor bronze. No. 0 Bc. S. hard drawn copper wire seemed to be most in favour.

Regarding *span wires*, 49 report using galvanised iron wire, 55 galvanised steel wire, 20 galvanised iron cable, and one as using copper wire. Mr. Mansfield's experience is that iron is not the proper material to use in any shape. It will rust, and then the structure is weak. He found that a certain special quality of silicon bronze wire was the best. The price of this is five or six times as great as that of iron wire, but as the total sum in either case per mile is small, he recommends it.

The descriptions of the various *feeder systems* were so vague that the author would not attempt to describe them. The average distance to which power is transmitted is about three miles. The greatest 10·7 miles.

Under the heading, *loads and conditions*, were included speeds, grades, number of cars hauled, passengers carried, &c. The average speeds of all the roads is 8·7 miles per hour. The maximum is 30. The average grade is 6·7 per cent., and but 12 roads report as having none, or very small ones. The maximum grade is 13½ per cent., and this extends for 1,500 feet. One road reports 11½ per cent. grade for 1,300 feet, and one 7½ per cent. for 3,000 feet. The loads carried up these grades by two 15 H.P. motors are, to say the least, surprising. They varied between 52 and 77 passengers per car, and in some instances a second disabled car was attached and safely propelled home.

English engineers, who are notorious for their liberal use of measuring instruments, will learn with surprise that out of 137 electric railways in the United States, only 32 report as having made any *tests* with either engines, dynamos, or motors, and 53 upon the overhead lines! Mr. Mansfield says rightly that this is lamentable, and that every railway should be continually testing its circuits, stations, and cars for leaks and grounds.

As regards *accidents*, not one road reports as having killed, or even seriously injured, an *employé* or passenger by the electric current, or by the falling of a wire. Several accidents are reported of collisions or running over, but these are inherent in any system.

Under the heading *miscellaneous*, the opinion of railway officials was asked as to the reliability, permanency, and safety of the electric system. All but one report most emphatically in its praise. This one prefers horses. There is universal praise and encomiums sounded on every side for the overhead system; 6,700 cars operated over 3,000 miles of track in the streets of 300 towns and cities surely testify to its merit and value. Of this number of towns and cities fully one-third have absolutely no other means of transportation. What objections there are are purely on sentimental grounds.

The discussion following this paper was short, and it consisted mainly of questions to which no definite replies could be given.

Mr. Knight Neftel read a short paper on "The Independent or Storage Battery Systems of Electromotive Power," enumerating the evident advantages of self-contained electric cars, and referring to several roads in the United States where such cars are in operation. It is curious that in none of the papers read at this convention the slightest reference is made to European practice. The author stated that the modern storage battery is still an unknown quantity as to durability. Some plates appear to be almost indestructible, while others, made practically in the same manner, deteriorate within a very short time. It is consequently very difficult to exactly and fairly place a limit on the life of the positive plates as yet. Speaking simply from observation of a large number of plates of various kinds, the author puts the limit to about eight months, though it is claimed by some of the more prominent manufacturers that elements have lasted much longer. The general conclusions which the last year's experience and progress have afforded him an opportunity to make may be summarised as follows:—Storage battery cars are as yet applicable only to those roads which are practically level, when the direct system cannot be used, and applicable to these roads only at about the same cost as horse traction.

This paper evoked an animated discussion, which was opened by Mr. Baumhoff, of St. Louis, who said that his company had no success with their battery cars.

Mr. Neftel replied that the experiments at St. Louis were made at least four years ago. Since then a great change had come over everything connected with the storage battery. Great progress is still going on in this direction, and we are not justified in throwing the thing aside as a failure. In answer to several other speakers Mr. Neftel stated that it is a mistake to expect batteries to make a long run. The future system will be one in which each car will make one trip, then newly-charged cells will be put in. There are six cars on the line in Washington and nine in Dubuque. On certain portions of the Washington road they are making 15 miles an hour. They run as regularly as any other system, whether electric, cable, or horse. He believes that in the near future storage battery cars will be run in competition, so far as economy is concerned, with any overhead system. When a car is run about 20 miles at the ordinary car speed, it will take about two hours and a-half to charge the batteries; but practice has shown that it is very foolish to draw out the entire charge of the battery. Such usage destroys the cells.

Mr. Montague stated that he had seen a storage battery car which took 85 passengers up a grade of 10 per cent., and did it steadily and easily. They do not allow the batteries, as a rule, to run more than 20 miles; but on special occasions they had to run 42 to 48 miles with one charge. It takes about 30 seconds to change the batteries.

Mr. Holmes pointed out that there is a loss of nearly 30 per cent. in passing the current through the battery. Then there is a loss of 25 per cent. on the motor, the same as in the trolley system, so that in the power problem we have 53 per cent. in the battery and 68 in the trolley. The difference in the battery and in the trolley car is vastly in favour of the latter.

Mr. Scott mentioned that he took during one week the mileage of the cars on the Dubuque road, and also measured at the dynamo the power put into the batteries. He was thus enabled to get from the mileage of the cars the amount of horse-power it took per car mile, and it was little less than one and a-half per car mile. The road has grades of over 6 per cent. On a level road it can be done with less power. He knew of one where it averaged for six months in a commercial way eight-tenths of a horse-power per car mile.

Mr. Crosby said that he had no doubt the future has such possibilities as none of us should dare to measure to-day. He would go so far as to say that in the future it will be possible to propel a car by electricity without tying it to a string from a station. We must bear in mind that both systems are using the same power applied differently. He did not believe the convention had the facts before it at this time to intelligently deal with this subject, and they could leave the matter for a time to those who are hard at work upon it.

The report of the committee on "Standards in Electric Railway Practice," was read by Mr. O. T. Crosby. The object of this paper was to present some suggestions concerning a standard rating of electrical machinery, standard dimensions for parts of car apparatus, standard nomenclature for methods and parts, and a standard method of keeping accounts. It is very doubtful whether any of the manufacturers of electric railway appliances will take much heed of Mr. Crosby's suggestions with regard to uniformity of dimensions of various parts of motors and gearing, but in the methods of keeping proper accounts of the working expenses on electric tramways it would certainly be useful if the items of operating costs were tabulated according to a uniform plan by all the companies.

"The Banquet," says the *Western Electrician*," was the crowning feature of the meeting, and was one of the most enjoyable affairs in the history of the organisation." One of the guests gave the toast, "New Sentiment—Quick Time," in which occurs the following passage, worth noting: "The man who formerly rode upon a street car did so because he was tired. The man who rides upon a street car to-day does so because he is in a hurry. No one in a hurry ever took a horse car. The American people can never get enough time." Very characteristic.

ADDITIONAL FACTS CONCERNING MAJOR BESSOLO'S EARLY ELECTRIC RAILWAY, WITH AN OVERHEAD CONDUCTOR.

By A. M. TANNER.

In a former article I set forth the claims of Major Alexander Bessolo (now of Turin, Italy) as having first proposed an electric railway system, in which an overhead conductor and the rails served as the circuit, and a rotary electric motor on a car was included in a travelling connection between said overhead conductor and the rails. In said article I considered certain patents granted to Bessolo in France and elsewhere, and stated that while the patents did not illustrate or specifically mention a travelling connection between the overhead conductor and the car motor, there was no reason to believe that Bessolo did not have such a travelling connection in view. It was during the same year, viz., 1855, that the Chevalier Bonelli, Inspector of Telegraphs of the Sardinian States, invented his so-called locomotive telegraph system, and worked it practically between Paris and St. Cloud. A French patent for said system was granted to Bonelli on the 9th day of January, 1855. It shows what is now known as "the third rail conductor," for conveying an electric current to a translating device upon the car through the medium of a contact device sliding upon said third rail conductor. In this system of Bonelli, as well as in others devised about the same time by de Castro, Guyard, du Moncel, and others, for establishing a telegraphic communication between a train and the stations, it was proposed to use a conductor insulated from the ground, and the rails as the circuit, and obviously in all these systems the translating device was in derivation between the insulated conductor and the rails. Consequently, when Bessolo stated that he proposed to use an overhead wire and the rails of a railway track as the circuit of a stationary generator of electricity, he obviously had the intention of completing the circuit through a travelling connection between the overhead conductor and the rails. This naturally placed the electric motor on the car in a branch or "leak" between the overhead conductor and the rails, just as is the case in all electric railways of the overhead conductor and trolley type. Everything concerning the genesis of an important invention is always of interest, and hence the writer has carefully investigated sources of information not accessible when his original article was written. It appears that an Austrian patent was granted to Bessolo on the 3rd day of December, 1855, and that the specification of this patent is in the Italian language, and Bessolo is mentioned at this time as Lieutenant in the Artillery of the Sardinian States. The original specification is in all essential particulars like that of the French patent, but a supplemental specification filed late in the same year, viz., 1855, recites many uses of his electric-motor; such as the operation of rotary fans and screw propellers, and the propulsion of vehicles on ordinary roads and railways. In reference to the propulsion of cars on railways, he again states (as in the French patent) that the current is conveyed to the locomotive motor machine by means of the rails and by a conductor insulated from the ground and suspended in a manner analogous to telegraph wires.

Then follows this statement: "Furthermore, such a system of locomotion unites many advantages, because the current can conveniently reach independent vehicles or those united in small trains; also, encounters or collisions on the same track are rendered impossible, because the same current will never allow two trains to be present in the same section of a common conductor; besides, the generators are so located that they can be controlled from the stations." In order to be considered an impartial chronicler of facts, the writer would say that the Austrian patent of Bessolo does not refer to the utilisation of natural forces for driving magneto-electric machines and the transmission of the generated currents to distant motors, as is the case in a certificate of addition of Bessolo's French patent. In fact, the Austrian patent did not contemplate anything more than the use of galvanic batteries for supplying an electric current to a car or vehicle motor, because the description nowhere states that a magneto-electric generator was intended to be used as the source of electricity. In a statement concerning the use of the motor for propelling vehicles on ordinary roads, it is stated that "the battery is only in action while the motor is working." The substitution of one form of electric generator for another in connection with an electric railway circuit formed in part of an overhead conductor and the track rails, could certainly never arise to the dignity of invention, and hence Alexander Bessolo must be considered as having in reality proposed and described the fundamental features of the modern overhead conductor electric railway system, as early as 1855. That Bessolo did not build an electric railway according to the system described by him, was not his fault. He was ahead of the times, and it needed the advent of the Gramme and analogous machines to bring the modern electric railway into practical existence. Engineering skill required to perfect partly developed ideas should be duly recognised; but the leviathans of modern electricity should not attempt to monopolise and control what was brought to light by intellectual workers in the field of science many years before this age of electricity.

DISTRIBUTION OF ELECTRICITY AT OXFORD.

THE system of electrical distribution that is being adopted by the Oxford Electric Supply Company will be watched with interest by electrical engineers, having been designed with the object of placing the continuous current motor-generator on an equality with the alternating current transformer in the matter of manipulation and control.

The local authorities, in giving their sanction for the electric lighting of the town, stipulated that continuous currents should be employed, and as the most desirable site for the generating station, with a view to water and coal supply, &c., is situated at a distance of about 1,200 yards from the centre of the area to be supplied, a high-tension converter system became necessary, and 1,000-volt continuous current generators with continuous current transformers to convert to 100 volts and feed into a network of secondary mains, were adopted.

The contract for the installation is in the hands of the Electric Construction Corporation, Limited, who have already completed the greater part of the machinery.

The main feature of the system is the arrangement whereby all the transformers in a district to be supplied can be completely controlled, stopped, or started, from one switchboard situated in the middle of the district; the H.T. current being supplied from dynamos running in parallel at the distant generating station to omnibus bars on the switchboard, from which it is distributed through separate switches to the H.T. armature of each transformer. A voltmeter above each switch is connected by pilot wires to the point in the secondary network at which the L.T. armatures supply current, and the H.T. and L.T. armatures of the transformers are connected and disconnected from the H.T. omnibus bars and L.T. network, respectively, according to the number of lights in use at one time, varying the number of transformers running with the conditions of the load during each part of the day. In this manner it is never necessary to run any transformer with less than 50 per cent. of its full load, and as the machines as constructed yield an efficiency of 84 per cent. at half load and 90 per cent. at full load, it is expected that the total efficiency of distribution will be very high.

The details of the circuit, &c., are shown in the diagrams, which are copied (with slight modifications) from the patent specification taken out in the names of Thomas Parker, works director of the Electric Construction Corporation, and J. H. Woodward and E. and G. Rees, the modifications being embraced in a later patent not yet published.

Fig. 1 gives the general arrangement of circuits for a district supplied by four transformers converting the H.T. current of three dynamos, with a small secondary battery at the switch station to supply current to the lamps during the hours of minimum supply, allowing the generating station to be shut down entirely. As the number of lights in use increases, the transformer, A, A′, situated at the switch station, is connected to the H.T. omnibus bars and its L.T. armature to the nearest point in the secondary network. Separate voltmeters (marked V) are connected to the L.T. mains at the points at which the distant transformers, marked B, B′, C, C′, D, D′, feed into the network. When these voltmeters

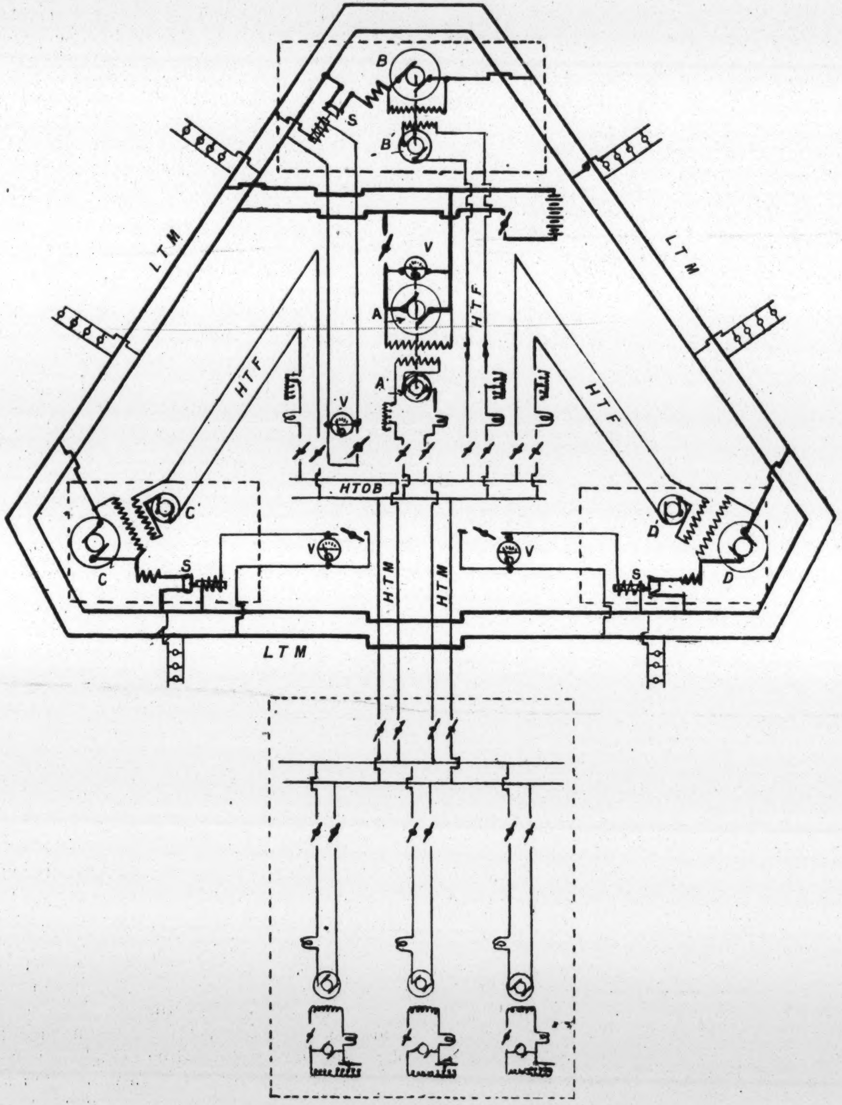


FIG. 1.

show that the E.M.F. on the L.T. mains is below the normal, the transformers are started up one by one, as shown in fig. 2, which gives one distant transformer, and the switches at the switch station for controlling the same.

Referring to fig. 2, the H.T. feeders are connected to the omnibus bars by means of the double-pole switches, the regulating resistance preventing a momentary excess of current. The current is supplied to the armature through a few turns of highly insulated wire wound round the magnets of the transformers, which partly magnetises the field, and passing through the H.T. armature causes the transformer to rotate when the L.T. armature generates an E.M.F., and the main magnetising coils, being connected as a shunt across the L.T. armature energises the field to the full extent. The resistance is now cut out of the H.T. circuit until the E.M.F. on the secondary armature is equal to the E.M.F. on the L.T. mains, as indicated on the voltmeter, V. The L.T. armature is then switched on to the mains as follows :—One of the voltmeter wires is connected to the mains through the winding of a magnetic switch, shown diagrammatically at S, the small current constantly passing through the voltmeter being insufficient to affect the switch. A switch is arranged at the switch station to short circuit the voltmeter, which allows the full current required by the magnetic switch to pass through the wires and cause the magnet, I, to ascend, when the circuit is again broken at the voltmeter switch, allowing the magnet, I, to descend again. The double movement rotates the cam wheel through $\frac{1}{8}$th of a revolution, and pressing the contact piece into the brushes of the switch, S, thus connects the L.T. armature to the L.T. mains. The voltmeter, only being momentarily short circuited, reads, as before, across the mains. The E.M.F. on the voltmeter is kept constant by means of the regulating resistance in the H.T. feeders, and the transformer is disconnected from the mains when the amount of current being supplied, as indicated on the ammeter, A, falls below a certain amount.

On disconnecting the transformer again, the resistance is once more inserted until the current falls to zero, indicating that the E.M.F. on the secondary armature is too low to supply any current to the mains, the switch S, is then broken by again short circuiting the voltmeter, rotating the cam wheel through another $\frac{1}{8}$th of a revolution and allowing the springs to pull the contact piece from the brushes. Thus there is no sparking at the brushes of the switch, S, as under ordinary circumstances the circuit through it is never broken while any current is flowing through it. The magnet, M, is connected to the L.T. feeders in such a manner that should the L.T. armature be switched on to the mains before the H.T. armature or before the L.T. armature is giving sufficient E.M.F., the excess of current flowing back from the L.T. mains will cause the armature of the magnet, M, to be attracted, knocking round the cam wheel slightly and breaking the circuit at S, again, but leaving the switch ready to be "made" again when necessary from the switch station.

By the above means each distant transformer is as com-

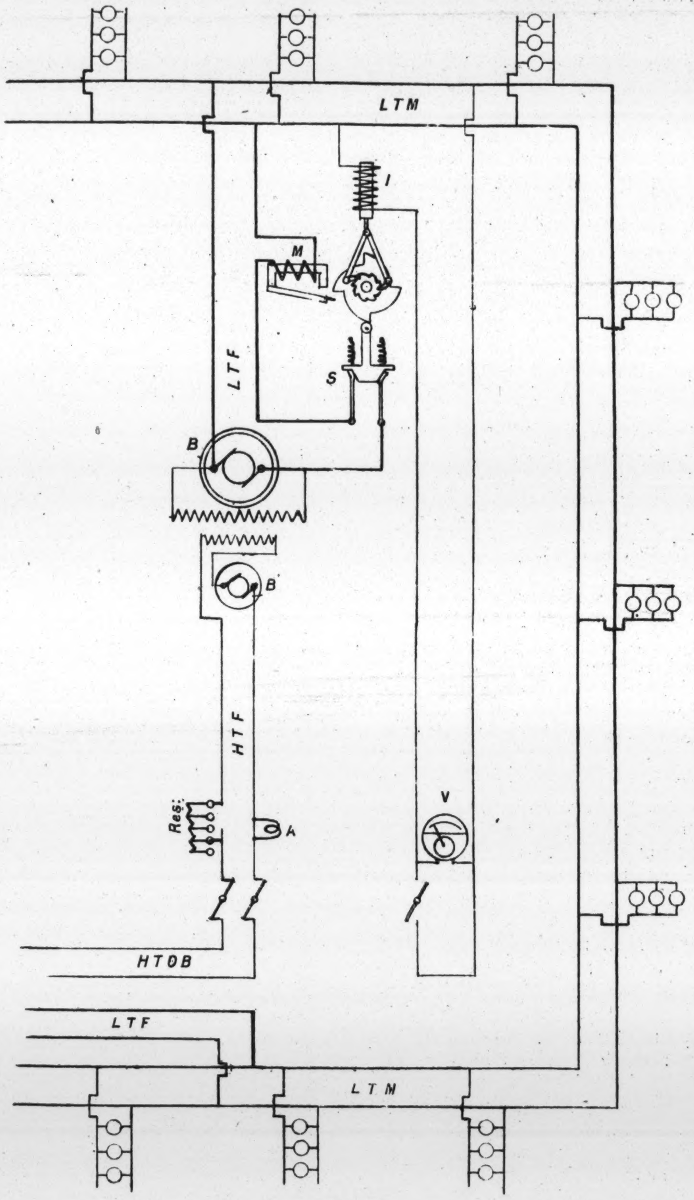


Fig. 2.

pletely under the control of the attendant at the switch station as the transformer fixed at that station, and as the oiling is automatic by means of oil pumps on the armature shaft the transformers themselves will only require inspection every three or four days.

The plant to be first installed at Oxford will be capable of supplying 7,500 running lights of 32 watts each. The buildings for the generating station are making good progress, and the current will be supplied early in the new year.

THE PARIS ELECTRIC UNDERGROUND RAILWAY.

ON August 10th last the Prefecture of the Seine posted a notice throughout Paris respecting the establishment of an underground tubular tramway, using electric traction, running from the Bois de Boulogne to the Bois de Vincennes. Hitherto, says a Parisian contemporary referring to this matter, the enquiry opened on August 17th, instead of exhibiting the usual difficulties connected with Parisian public affairs, has met with much cordiality. In connection with the ill-success of the mechanical traction tramway running from Belleville to the Place de la République, the moment is opportune for placing parallel with this the advantages and conveniences of electric traction, following on the decisive experiment of the City and Southwark Railway. It is now possible to follow the project as far as it has been accepted by the Municipal Council.

The system adopted is that presented by M. J. B. Berlier. The concession includes an underground tunnel nearly following the course of the Seine, and traversing Paris at its greatest breadth. There are to be six stations, and a generating depôt at the end of the line. We need devote no space here to the construction of the tunnel, as it will be very similar to that of our London electric railway.

The lighting question is, of course, of great importance, and is to be solved by the creation of a special service established at the works at the end of the line, and will include arc lighting for the stations and incandescent lights for the carriages, signals, and for the general service of the tunnel throughout its length. The electricity generating machinery will be duplicated, so as to provide against breakdowns.

Electric traction will have a preponderating part to play in this new scheme, and it must not be forgotten that electricity has, in many instances, dethroned cable traction, and as Paris has no application of this nature M. Berlier's plan is necessarily of great interest.

The following is M. Berlier's arrangements for the position of the conductors. The transversal sleepers of injected wood are placed a mètre apart; on these run two parallel ways formed of rails 30 kilos to the running mètre. In the middle of each line of metals is placed a central rail insulated by India-rubber plates from the sleepers to which it is fastened. The conductor, thus insulated and perfectly sheltered, is protected against all loss due to atmospheric causes, which are always present in aerial lines. The motor carriage carries under its framework two motors established on the same circuit, to the shafts of which are directly attached the wheels of the vehicle. The motors are each of 25 horse-power, and will be regulated for proportionate speeds and for stoppages by a rheostat regulator, while the reversing of the machinery will be effected by a special commutator. A similar arrangement will be adopted for the interior lighting of the carriages; in addition to which, during the journey, all the doors will be closed by an electric bolt under the charge of the engine driver. On arriving at a station they will be released and will open automatically. Our contemporary also gives a mass of statistics, basing its calculations on the figures of the City and Southwark Railway, which are of no interest to our readers; but we may quote its concluding remark, which is as follows:—"In short, this first attempt at a metropolitan railway merits our attention, the more so as it will be completely worked by electric means, and that it offers a solution as perfect as possible of the complicated question of the transport of passengers to the centre of Paris."

WOODHOUSE AND RAWSON.

ISSUE OF FURTHER CAPITAL.

THE directors of Woodhouse and Rawson United, Limited, invited applications for 10,000 ordinary shares of £5 each, 13,000 preference shares of £5 each, and £50,000 5½ per cent. debenture stock, the balance of the new capital authorised to be issued at the general meeting of shareholders held on January 9th last. On the ordinary shares there is no present intention of calling up more than £2 10s. per share. The new issue will, therefore, add £90,000 to the share capital and £50,000 to the debenture capital of the company, which stood in the accounts published in our last issue at £348,807 10s. and £150,692 respectively. On the subscription, and payment as far as contemplated, of the present issue, the share capital will be £438,807 10s., and the debenture capital £200,692, together making a total capital of £639,499 10s.

In the advertisement inviting the public to apply for shares, the directors referred to the steady and progressive increase of electrical work of every kind, and the evident prospects there were for a company laying itself out to take advantage of all new applications of electricity; they drew attention to the dividends of 8 per cent. on the preference, and 15 per cent. on the ordinary, shares which had been paid for the past two years, and they were able to state that the outlook for the company continued to be of the same satisfactory character.

We quoted last week from a financial contemporary an article which criticised the report of the company in such detail as to make it unnecessary for us now to give many figures. We may draw more particular attention to the statement that "in point of fact the year 1890-91, so far from earning the 15 per cent. dividends declared on the ordinary shares, has earned only 7½ per cent." As the amount brought forward from the previous year sufficed to make up the difference and provided also a balance to carry forward, we make this reference without any particular bearing on the declaration of the full dividend, but rather as having a very particular bearing on the statement of the directors as to the future outlook, upon which statement we presume the public who may have applied for shares would largely rely.

One of the shareholders at the meeting said that for the present it was not wise to extend the business too much, but that it would be wiser to wait until they were more established and had a larger reserve. Another shareholder wished to say a word as to the policy of locking up their immense capital; but as an amendment to adjourn the meeting for a fortnight, to enable the directors to review the accounts, received the support of only four shareholders, we may assume that the policy of the directors receives the approval of the majority of the shareholders. Yet, we think, that the remarks of those who would doubtless be called "dissentients" were in the best interests of the shareholders, regarded from any other point of view than that of the immediate present, and we think that the public who may contemplate investing in the company should seriously consider the circumstances of the present issue.

The application of capital for the extension of electrical businesses is most desirable, but it is necessary that the extension should be of a practical character and afford prospect of a reasonable return on a business basis. We have already alluded on several occasions to the fact that the profits of Woodhouse and Rawson United apparently show small returns from manufacturing, and large returns from promoting. The present issue of capital, when paid up to the extent contemplated, will amount to £140,000. The "sundry investments" in the last accounts amount to £119,338 15s. It is clear that the new issue would be unnecessary if the sundry investments did not exist. The directors, we have no doubt, were acting in the best interests of the Company in declining to state for general information what the investments are, but though they may rightly refrain from giving information, they cannot prevent anyone thinking that the investments are more likely to be connected with the promoting than with the manufacturing department; and upon the realisation of these investments much depends. It is difficult to reconcile the anxiety to withhold particulars of them with the statement that they are not speculative. It is difficult to believe that confidence in their value will be strengthened by the statement that if the nature of the investments in the previous report had transpired, it was not at all likely that they could have been "got off at a profit."

It is noticeable that the declaration of the last two half-yearly dividends has been followed by the issue of new capital. On February 6th we announced the declaration of a dividend, and on February 20th we announced the issue of new capital. Last week we published the report proposing the second half-yearly dividend, and this week the further issue of new capital is announced. The amount of the present dividend is £16,043. It is of course nothing more than a coincidence, but it is noticeable that the payment of the 10s. per share and the 10 per cent. on the debenture stock which are required on application, produces for the whole issue, £16,500.

A company which has paid 15 per cent. dividends for four consecutive half years is likely to favourably impress the public when it requires further capital, and thus it is all the more necessary that we should call attention to some features which are less satisfactory, but which ought to be considered.

AN INCANDESCENT ELECTRIC LIGHTING PATENT OF 1874.

WE referred in our last issue to an American patent granted in the year 1874 to Henry Woodward and Mathew Evans, and, as promised, we now place before our readers a short description of same, which we reproduce from a copy of the specification, now in our possession. As already stated, the patent is entitled "Improvements on the Art or Process of Obtaining Artificial Light by Means of Electricity."

The inventors used a gas engine for the purpose of rotating a dynamo-electric machine at a velocity sufficient to generate enough current to heat pieces of pure carbon placed in a lamp to a state of incandescence; the carbons of course being of proportionate size to the lamp used. An electrode was connected to the carbon at the top, and the other electrode was connected at the bottom, by drilling a small hole into each end of the carbon, and, if necessary, they might be further secured with a portion of plaster of Paris, or other similar suitable substance; the electrodes not being allowed to pass through the carbons, or to be connected with each other. The whole was then enclosed in a glass globe or other vessel of suitable material, the air being extracted from the globe after it had been hermetically sealed at the ends. It was then filled with rarefied gas.

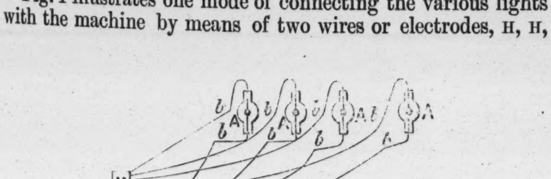


FIG. 1.

The process would give a light of any required intensity, and a number of lights could be obtained from one dynamo.

Fig. 1 illustrates one mode of connecting the various lights with the machine by means of two wires or electrodes, H, H, running from the positive and negative poles, M and N, of the machine, with branches, *b*, *b*, therefrom to each light.

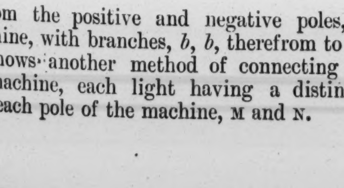


FIG. 2

Fig. 2 shows another method of connecting the lights with the machine, each light having a distinct wire, *b*, running to each pole of the machine, M and N.

Having thus described their process the inventors claim—the placing of carbons in lamps or other suitable vessels filled with rarefied gas, possessing the property of not chemically combining with the carbon when in a state of incandescence, in connection with the arrangement of the electrodes, fixing or connecting the carbon substantially as set forth.

ELMORE'S COPPER PROCESS.

IN the course of our enquiries into the value of the Elmore process from a commercial standpoint, and the value of Elmore shares as an investment, we have had occasion to criticise the information furnished, and the conclusions drawn from it, by some of our—more particularly financial—contemporaries. The *Financial News* is one instance, and *Truth* is another. So far as we are aware, neither of these newspapers has at any time advised caution in considering Elmore shares as an investment, but the *Financial Times* has, in its own words, "consistently advised its readers to leave the shares of these companies alone," and we are, of course, the more surprised when we find the *Financial Times* leaving this consistent attitude for one of less consistency. But, fortunately, our contemporary gives its reasons for its past attitude and its present one. By examining both, we may form some impression of which was most likely to be of benefit to its readers :—

> Will (? Robin) the Grinder, it will be remembered, always attributed his misfortunes to the fact of his having been made a grinder, and thus led into bad company. William Elmore and the Elmore Companies may fairly ascribe the position they hold to-day in the minds of the investing public to a somewhat similar reason. Fathered by a company, with a reputation none too savoury, and made to serve the purposes of paying dividends for that company in a manner similar to that in which Will the Grinder was compelled to serve good Mrs. Brown, it is not surprising that people looked askance at the concerns and rated them according to the company they kept. We will freely admit that we ourselves have been more influenced by these circumstances than by any consideration with regard to the value of a patent which was undeveloped and untried. A company brought out with a flourish of trumpets, and whose shares, despite bad times, are run up to a premium of 400 per cent., savours far more of the rigging promoter than of the honest mechanic or patentee, and we have no reason to regret that we have consistently advised our readers to leave the shares of these companies alone.
>
> Under such conditions investors are playing with loaded dice. If the public are led to believe the wild reports circulated to screw up prices to a point at which the promoters are able to clear out at a grand profit they soon find themselves proprietors of shares at a price far in excess of intrinsic merits, and a shrinkage in value occurs as soon as the promoters' pressure is withdrawn. If, on the other hand, they estimate the concern at its true value and sell short, they promptly find themselves in a hot corner. Shares of this description are, therefore, of no concern to the prudent investor, and up to the present the Elmore Companies have been in this condition.

This would seem to be confirmation from a high authority that our attitude, at least thus far, has been correct, but the *Financial Times* believes the "riggers have finished now, and that the present price of the shares confirms this belief."

What has led to our contemporary's change of attitude? A visit to the works, and some figures supplied by Mr. William Elmore. It was figures supplied by Mr. William Elmore on which the *Financial News* article some months ago was based. It was a visit to the works, figures of Mr. William Elmore and inspection of testimonials from many firms of the highest standing (we presume the same as those published in fac-simile later) that supplied *Truth* with material for frequent and consistent recommendations to purchase shares. If we are to believe the *Financial Times* the market for Elmore shares has been "rigged," and the "rigging" has only now finished. We may, therefore, find some advantage in examining more narrowly the reasons for our contemporary's change of belief.

Of our contemporary's visit to the works, little need be said. It is much the same as other visits. The Copper Depositing Works, and the Wire Works are still on adjacent plots, the railway and canal are still there, and the wire works are still "not yet finished" though, to judge from the description, some additions have been made to the machinery since we were given an opportunity of inspection.

The process of making copper tubes is still very simple, and the advantages resulting from making articles by this process still apparent. As all this, however, is not very new we turn to that for which we have long been waiting—figures "derived from actual working and not from estimates." These are furnished by Mr. William Elmore, and are as follows :—

> The present capacity of the works is 20 tons per week, and they are fully employed. The total working expenses are less than £100 per week. The lowest price obtained for finished articles is £100 per ton, but in many cases as much as £200 per ton is obtained at current rates. In this statement no credit is taken for the better price allowed for the superior work which it is claimed is produced by this process. The price of Chili bars averages over a series of years £55 per ton, and the value of the precious metals extracted simultaneously with the deposits of copper, and without any additional expense, is £8 per ton. Working out the problem, we have :—

INCOME.

Twenty tons of copper articles manufactured per week, at £100 per ton, for 52 weeks	£104,000
Precious metals extracted from ditto, at £8 per ton, for 52 weeks	8,320
	£112,320

EXPENDITURE.

Twenty tons of Chili bars per week, at £55 per ton, for 52 weeks	£57,200	
Working expenses, 52 weeks, at £100 per week	5,200	
		£62,400
Leaving a net working profit per annum ...		£49,920

With these figures before us, we see no reason to enter into any discussion of the merits of the Elmore process, the value of their patents, or anything else. Whether in the shape of "articles" or ingots, there is always a market for electrically-refined copper. We believe it is usually sold at higher rates than Chili bars ; but these figures show that the Elmore Company can undersell Chili bars to the extent of £1 per ton, and make £2 profit on every ton treated by residual products alone. Had we considered the other details to be worth going into, we might have pointed out that "income" is not usually counted on the "manufacture" of articles, but on their sale, and no particulars of the sales are given ; but with gold mines such details need not be considered, and our only wonder is that the report of the Company which last year was issued in July, has not yet, so far as we are aware, been issued, for this year. When issued, it will doubtless give particulars of the proceeds from the precious metals separate from other items. Notwithstanding the very promising nature of the information furnished by our contemporary, we strongly advise the public not to invest on the strength of these figures, until they can learn from the accounts that 20 tons per week have been sold at £100 per ton, that the cost of working is £5 per ton, and that the resulting precious metals amount to as much as £8—not on one exceptional ton, but as an average of all that are treated. Our contemporary and ourselves have held very similar views on this subject hitherto. We are sorry that the information it now furnishes does not suffice to lead us as it does the *Financial Times*, to believe that from an investor's standpoint there is as yet "something in the process of financial value apart from share rigging."

DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE third annual dinner of the Institution was held at the Criterion Restaurant last Friday evening, the President, Prof. Crookes, in the chair. There were also present Sir G. G. Stokes, M.P.; Mr. George Berkley, President of the Institution of Civil Engineers; Sir F. Abel, K.C.B.; Mr. Latimer Clark, Mr. W. H. Preece, Lieut.-General R. Grant, C.B., Inspector-General of Fortifications; Major-General C. E. Webber, C.B.; Sir John Pender, K.C.M.G.; Prof. W. Grylls Adams, Mr. C. E. Spagnoletti, Sir Robert Rawlinson, K.C.B.; Sir Thomas Blomefield, Prof. Hughes, Prof. Fleming, Captain W. J. L. Wharton, R.N.; Sir Benjamin Baker, K.C.M.G.; Sir Henry Mance, C.I.E.; and some 140 other gentlemen. Before proceeding to the toast list, the President expressed his regret for the absence of the Postmaster-General, who had promised to be present, of Mr. Tomlinson, President of the Institution of Mechanical Engineers, and of Mr. Giles, M.P., Vice-President of the Institution of Civil Engineers.

After the health of the Queen had been duly honoured, the PRESIDENT, in proposing the toast of the health of the Prince of Wales and the other members of the Royal Family, took occasion to congratulate his Royal Highness on the attainment of his 50th birthday. The toast of the Army, Navy, and Reserve Forces was replied to by Captain Wharton, R.A., Lieutenant-General Grant, and Colonel Du Plat Taylor.

The PRESIDENT, in proposing the toast of the evening, "Electricity in Relation to Science," said: We have happily outgrown the preposterous notion that research in any department of science is mere waste of time. It is now generally admitted that pure science, irrespective of practical applications, benefits both the investigator himself, and greatly enriches the community. "It blesseth him that gives, and him that takes." Between the frog's leg quivering on Galvani's work-table and the successful telegraph or telephone there exists a direct filiation. Without the one we could not have the other. We know little as yet concerning the mighty agency of electricity. "Substantialists" tell us it is a kind of matter. Others view it, not as matter, but as a form of energy. Others, again, reject both these views. Prof. Lodge considers it "a form, or rather a mode of manifestation, of the ether." Prof. Nikola Tesla demurs to the view of Prof. Lodge, but thinks that "nothing stands in the way of our calling electricity ether associated with matter, or bound ether." High authorities cannot even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is, if like life or like matter it should remain an unknown quantity, we shall assuredly discover more about its attributes and its functions. The light which the study of electricity throws upon a variety of chemical phenomena—witnessed alike in our little laboratories and in the vast laboratories of the earth and the sun—cannot be overlooked. The old electro-chemical theory of Berzelius is superseded, and a new and wider theory is opening out. The facts of electrolysis are by no means either completely detected or co-ordinated. They point to the great probability that electricity is atomic, that an electrical atom is as definite a quantity as a chemical atom. The electrical attraction between two chemical atoms being a trillion times greater than gravitational attraction is probably the force with which chemistry is most deeply concerned. It has been computed that in a single cubic foot of the ether which fills all space, there are locked up 10,000 foot-tons of energy which have hitherto escaped notice. To unlock this boundless store and subdue it to the service of man is a task which awaits the electrician of the future. The latest researches give well-founded hopes that this vast storehouse of power is not hopelessly inaccessible. Up to the present time we have been acquainted with only a very narrow range of ethereal vibrations, from extreme red on the one side to ultra-violet on the other—say from 3 ten-millionths of a millimetre to 8 ten-millionths of a millimetre. Within this comparatively limited range of ethereal vibrations, and the equally narrow range of sound vibrations, we have been hitherto limited to receive and communicate all the knowledge which we share with other rational beings. Whether vibrations of the ether, slower than those which affect us as light may not be constantly at work around us, we have until lately never seriously enquired. But the researches of Lodge in England and Hertz in Germany give us an almost infinite range of ethereal vibrations or electrical rays from wave lengths of thousands of miles down to a few feet. Here is unfolded to us a new and astonishing universe—one which it is hard to conceive should be powerless to transmit and impart intelligence. Experimentalists are reducing the wave lengths of the electrical rays. With every diminution in size of the apparatus the wave lengths get shorter, and could we construct Leyden jars of molecular dimensions the rays might fall within the narrow limits of visibility. We do not yet know how the molecule could be got to act as a Leyden jar; yet it is not improbable that the discontinuous phosphorescent light emitted from certain of the rare earths, when excited by a high tension current in a high vacuum, is really an artificial production of these electrical rays, sufficiently short to affect our organs of sight. If such a light could be produced more easily and more regularly, it would be far more economical than light from a flame or from the arc, as very little of the energy in play is expended in the form of heat rays. Of such production of light, Nature supplies us with examples in the glow-worm and the fire-fly. Their light, though sufficiently energetic to be seen at a considerable distance, is accompanied by no liberation of heat capable of detection by our most delicate instruments. By means of currents alternating with very high frequency, Prof. Nikola Tesla has succeeded in passing by induction through the glass of a lamp energy sufficient to keep a filament in a state of incandescence without the use of connecting wires. He has even lighted a room by producing in it such a condition that an illuminating appliance may be placed anywhere and lighted without being electrically connected with anything. He has produced the required condition by creating in the room a powerful electrostatic field alternating very rapidly. He suspends two sheets of metal, each connected with one of the terminals of the coil. If an exhausted tube is carried anywhere between these sheets, or placed anywhere, it remains always luminous. The extent to which this method of illumination may be practically available experiment alone can decide. In any case, our insight into the possibilities of static electricity has been extended, and the ordinary electric machine will cease to be regarded as a mere toy. Alternating currents have at the best a rather doubtful reputation. But it follows from Tesla's researches that as the rapidity of the alternation increases they become not more dangerous, but less so. It further appears that a true flame can now be produced without chemical aid—a flame which yields light and heat without the consumption of material and without any chemical process. To this end we require improved methods for producing excessively frequent alternations and enormous potentials. Shall we be able to obtain these by tapping the ether. If so, we may view the prospective exhaustion of our coal-fields with indifference; we shall at once solve the smoke question, and thus dissolve all possible coal-rings. Electricity seems destined to annex the whole field not merely of optics, but probably also of thermotics. Rays of light will not pass through a wall, nor, as we know only too well, through a dense fog. But electrical rays of a foot or two wave-length of which we have spoken will easily pierce such mediums, which for them will be transparent. Another tempting field for research, scarcely yet attacked by pioneers, awaits exploration. I allude to the mutual action of electricity and life. No sound man of science endorses the assertion that "electricity is life;" nor can we even venture to speak of life as one of the varieties or manifestations of energy. Nevertheless, electricity has an important influence upon vital phenomena, and is in turn set in action by the living being—animal or vegetable. We have electric fishes—one of them the prototype of the torpedo of modern warfare. There is the electric slug which used to be met with in gardens and roads about Hornsey Rise; there is also an electric centipede. In the study of such facts and such relations the scientific electrician has before him an almost infinite field of enquiry. The slower vibrations to which I have referred reveal the bewildering possibility of telegraphy without wires, posts, cables, or any of our present costly appliances. It is vain to attempt to picture the marvels of the future. Progress, as Dean Swift observed, may be too fast for endurance. Sufficient for this generation are the wonders thereof. I have great pleasure in coupling with this toast the name of Sir George Stokes.

Sir George Stokes, in replying, said he regretted the absence of the President of the Royal Society (Sir Wm. Thomson), who could, so much better than he, respond to such a toast. His task, however, was lightened by the President himself who had touched upon many of the subjects, in which electrical science touched upon other sciences. Among the various individual sciences, he thought there was hardly one to compare with electricity in the multitudinous points of contact which it had with other sciences, apparently remote, and in the remarkable way in which abstract theoretical investigations found their application in actual practice. In the first instance, it was very closely connected with chemistry. The discovery by Faraday of the law of electro-chemical equivalent, showed how close that connection must be. Not only could electricity, no matter how produced, be employed in the decomposition of chemical substances, but in some cases in the synthesis also. On the other hand, till comparatively lately, chemical combination formed one of the principal sources of electric current which were actually employed. That, now had in a great measure given place to other means of producing electricity, and the ultimate source of power was not the chemical combination in the cells of the battery, but mechanical force however obtained, no doubt very commonly attained ultimately by chemical combination in another sense, *i.e.*, between the carbon and oxygen in the coals that lie under the boiler of a steam engine. To go back to the original discovery of electro-chemical equivalent, they saw there, how very closely the two subjects must be united. They did not know what electricity was, he thought in some respects that they knew a good deal more about light than they did about electricity. Thirty-nine years ago he was sitting at dinner, during a meeting of the British Association, by the side of the illustrious Faraday, and he (the speaker) said to him that he thought it would be a great step made, if they could say as much of electricity as they could of light in that it consisted in vibrations. Faraday replied that, he thought, they were a great length from that. Nevertheless (continued the speaker) the connection between light and electricity had been rendered much more close by recent researches. First, he would mention that remarkable discovery of Clerk Maxwell, which showed that certain velocities palpable, though not directly observed as velocity, were calculable from the values of certain constants which could be obtained in the laboratory, as within the limits of investigation, the velocity of the propagation of light; and, indeed, they might say that an electrician in his laboratory—in some basement, perhaps—might determine the constant which helped them to determine the distance of the earth from the sun, remote as those two things appeared to be. That was one example of the marvellous way in which the science of electricity touched upon others. He would say that now the connection between light and electricity had been brought still more closely by that remarkable investigation of Prof. Hertz, which their President had referred to.

Mr. C. E. Spagnoletti, in proposing "Electricity in its Practical Application," called attention to the importance of the telegraph and the telephone to all classes of the community, and dwelt at length on the additional safety provided on the railways by means of electric signals.

Sir John Pender, in responding, spoke upon the commercial position of the submarine telegraph and electric lighting.

Mr. W. H. Preece next proposed "Our Guests," to which Mr. Berkley replied.

Sir G. Stokes proposed the "Institution of Electrical Engineers," and in responding, the President said: I am perplexed how best to acknowledge the honour you have done me. I am no speech-maker. I have been accustomed to deal with *things*, their properties and changes, rather than with *words*. But pray do not suppose I am at all indifferent to your kindness. Sympathy is no less dear to the strugglers of science than to those engaged in other more popular pursuits. It is perhaps more dear, because, as is only natural, our work inevitably appeals to the few, not to the many. I have given you some indication of the intricate problems to be handled, of enormous difficulties to be surmounted. What is really in store in the way of future wonders is folded "in shady leaves of Destiny."

LONDON COUNTY COUNCIL.

The Highways Committee submitted the following at the last weekly meeting:—

Inspector of Subways.

We have considered as to the fresh arrangements necessary upon the retirement from the service, on account of physical infirmity, of E. Merry, late Inspector of Subways, to whom the council on October 20th last granted a retiring allowance. We have ascertained that F. McMahon, who was appointed in February, 1890, at the wages of 26s. a-week as an assistant inspector, is qualified for the position of inspector; and we are of opinion that he should be promoted to that post, but that he should not at once receive the maximum pay. We recommend that F. McMahon, at present assistant inspector of subways, be promoted to the position of inspector; and that his wages be at the rate of 30s. a week for the first year, rising by instalments of 1s. per week each year to 35s.

Should the council adopt the above recommendation, we will at a future time submit the name of a person for appointment as assistant inspector.

Subways—Queen Victoria Street.

The engineer of the City of London Electric Lighting Company has applied for the council's sanction to the use for three weeks, at the eastern end of Queen Victoria Street subway, of two ordinary transformers, for the purpose of assisting in making certain experiments in reference to the possible effects of induction by the electric light mains about to be laid down in the City. We see no reason for objection to the use, subject to proper conditions, of the subway for this purpose for the short period stated; and we recommend that permission be granted for the use by the City of London Electric Lighting Company for three weeks of two ordinary transformers in the Queen Victoria Street subway, upon the following conditions:—That the transformers shall be installed and removed at such times as the chief engineer of the council may appoint, and that when in use they shall be in the charge of a person in the company's employ; that all work connected with the installation and removal of the transformers shall be carried out at the risk and cost of the company, and to the satisfaction of the council's chief engineer; and that the company's operations shall be so conducted as not to interfere in any way with the ordinary use of the subway.

If sanction be given as recommended above, we propose to ask the company to communicate to the council, for its information, the results of the experiments carried out in the subway.

Electric Lighting—St. Pancras.

A letter has been received from Mr. Robinson, the engineer to the Vestry of St. Pancras, with reference to the precautions which the vestry proposes to take to prevent risk of accident from the electric lighting cables which are being laid down in the parish under the St. Pancras Order, 1883. It is suggested that where the high-tension cables pass through the boxes they shall be guarded by a semi-circular stoneware cover, except in those few cases where it may be found difficult to fit the cover, and in these exceptional instances it is proposed that substantial wooden casing shall be used. By adopting these means it is expected that contact between the cables and the iron man-hole covers of the street boxes will be rendered absolutely impossible. We are informed that these suggestions are approved by Major Cardew, who has looked into the subject on behalf of the Board of Trade; and we are of opinion that they may be approved by the council. We, therefore, recommend that the council do signify its approval of the plan proposed to be adopted by the vestry of St. Pancras for the prevention of accident from the electric lighting cables laid down by the vestry under the provisions of the St. Pancras Electric Lighting Order, 1883.

The Solicitor having pointed out certain legal difficulties, and the council being precluded from making advances for work other than street improvements for more than thirty years, the committee reported that the loan should be granted on various conditions, one being that it was repaid within thirty years.

Lord Lingen, as chairman of the Finance Committee, presented its report, in which they said they had considered the application of the Vestry of St. Pancras for a loan of £60,000, for electric lighting works, repayable in 42 years. The loan was required towards defraying the cost of erecting a central station at the rear of Stanhope-street (upon a freehold site purchased by the vestry), to provide accommodation for the necessary machinery for supplying the electric current, and consisted of an engine-house, boiler-house, battery-room, store and other offices, at a cost of £5,700, and a sub-station built in the large open space under the public roadway, at the South end of High-street, Camden Town, at a cost of £500. The total cost was estimated at £62,999 7s. 5d. The committee recommended that £56,000 be advanced, repayable by equal annual instalments on each October 31st, commencing October 31st, 1894, as to £32,400 within a period of 30 years, as to £20,800 within 15 years, as to £2,700 within eight years, and as to £400 within five years, from the date of the advance.

Mr. Eccleston Gibb said the policy indicated in the report of not lending the money for forty-two years would have the effect of destroying the work of the vestry. If it was impossible for the council to lend the money to the vestry on the terms asked, it would be necessary to go to Parliament to borrow, and Friday was the last day on which notice could be given.

Lord Lingen said the Finance Committee met next day, and the difficulty of giving Parliamentary notice might be met.

Mr. Wetenhall stated that there was a greater demand for electric light in St. Pancras than they could supply. St. Pancras had taken the initiative in electric lighting, and he hoped everything would be done to assist so great a work

After some further discussion it was agreed that the report should be referred back to the committee.

Notices under Electric Lighting Acts and Orders.

We have considered a notice, dated November 9th, 1891, from the Electricity Supply Corporation, of intention to lay cables and to construct street-boxes along both sides of and across Spring Gardens and along The Mall, St. James's Park (1 plan). With that part of the notice which relates to The Mall the council has no concern, that place being under the jurisdiction of Her Majesty's Office of Works; and to the other portion of the proposed works, which are of the same description as those of this company previously approved by the council, we see no objection. We recommend that the sanction of the council be given to the works referred to in the notice dated November 9th, 1891, of the Electricity Supply Corporation, so far as such notice relates to places within the jurisdiction of the council, upon condition that the company do give two days' notice to the council's chief engineer before commencing the work; that the mains shall be laid in the footways wherever it is found practicable to do so; that the concrete floor of the road-boxes shall be made 9 inches thick; that the York stone on the top shall be 4 inches thick; that the brickwork of the boxes shall be 9 inches thick; and that the longitudinal girders on all the boxes shall be laid in 3-inch stone templates the full thickness of the brickwork.

We have also to report the receipt of the following notices, given in accordance with the resolution of the council to accept four days' (instead of one month's) notice in respect of the laying of service lines from mains already laid:—From the London Electric Supply Corporation, November 2nd, 1891, to 34, New Tothill Street, and the Canterbury Music Hall; November 9th, 1891, to 42, Newington Causeway; November 11th, 1891, to 116, New Bond Street, 21 and 22, Charing Cross, 13, Stratton Street, and 57, Rupert Street. From the St. James and Pall Mall Electric Lighting Company, November 2nd, 1891, to 64, Pall Mall, 7 and 8, Park Place, 53, Piccadilly, and Burlington House; November 3rd, 1891, to 10, Saville Row; November 6th, 1891, to 248, Regent Street; November 10th, 1891, to 155, Regent Street. From the Electricity Supply Corporation, November 9th, 1891, to basement of Grand Hotel (hairdresser's shop).

POLYPHASED ALTERNATE CURRENTS.

(Continued from page 557.)

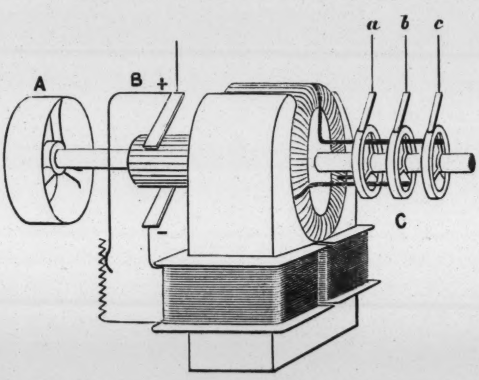
VI.—MULTIPLE TRANSFORMERS.

AFTER discussing the application of polyphased alternate currents to the production of lighting by incandescence and of motive power, we are naturally led on to the study of the processes by which these currents can be transformed into continuous currents to meet the requirements of electro-chemical operations, the charging of accumulators, and other applications to which we shall have occasion to refer. These transforming apparatus, to which we give the provisional name of *multiple transformers*, are now invented and practically realised. The Frankfort Exhibition has made us acquainted with two very distinct types, one for triphased currents, devised by M. Dolivo-Dobrowlsky, and the other for diphased currents, by M. Schuckert. We will in this article discuss the triphased *multiple transformers*; the corresponding apparatus for diphased alternate currents will be described when we come to diphased currents.

In order to thoroughly understand the principle of the multiple transformers, to which, properly speaking, we should give the name of

Continuous Current and Polyphased Alternate Current Generator-Motors,

we have merely to glance at the figure below, which shows the apparatus reduced to its essential elements: A Gramme ring provided with collector and brushes, excited either in derivation or by a separate source. To three points of the winding, 120° apart, are connected three derivation wires communicating with three insulated collecting rings, on which rub three brushes connected with three wires, *a*, *b*, *c*. A pulley is fixed upon the axle bearing the ring and the collector. We will represent by A the pulley, by B the collector and its brushes, and by C the three collecting rings, *a*, *b*, and *c*, and their brushes.



Generator motor for continuous and triphased alternate current (Diagram showing the principle).

An apparatus constructed in this manner is capable of six essentially distinct functions, and this justifies the length of the name which we have coined in order to define it.

1. By making the pulley, A, turn mechanically, we get at B a continuous current. Thus the system works as a *continuous current dynamo*, and is really nothing else.

2. By supplying a continuous current at B the ring is made to turn, and mechanical power is obtained at the pulley, A. In this second case we have a *continuous current motor*. These two functions are well known, and we only mention them with the idea of giving a complete list of all the functions of which the apparatus is capable.

3. By supplying mechanical power to the pulley, A, it turns, is excited, and is, as we have seen, capable of producing continuous current at B. But if, instead of collecting the current at B, we collect it at C, on the three brushes, *a*, *b*, *c*, we shall obtain triphased alternate currents, and we shall thus get a *triphased alternate current generator*, which is self-excited by a continuous current which it produces itself. This is a very convenient method of constructing, at little expense, a triphased alternate current generator. Any shunt dynamo lends itself readily to this transformation by the addition of three rings on the extremity of the axle opposite to the collector, and connecting these rings to three points of the armature windings selected at 120° apart.

4. By supplying triphased alternate currents to the three rings, *a*, *b*, *c*, when once synchronism is established between the angular speed of the axis of rotation and the frequency of the alternating currents, we get a *synchronous alternate current motor*, and collect mechanical power at the pulley, A. The apparatus thus works as a synchronous alternate current motor. It must be observed that the working of this synchronous motor differs essentially from that of the motors with a revolving magnetic field which we have described in a former article. These motors can, in the first place, be only started when free without any load, and when not excited. The initial motive *torque* is produced by the reactions of the armature on the inductors. When synchronism is obtained the machine can be excited with its own current, and under these conditions, this synchronism is kept up, even when the machine is loaded, but it is indispensable to the working. The revolving field motors have the property of slackening their speed with the charge, and are even capable, if the resistance of the induced circuit is made to vary, of turning at any speed whatever. The alternate current motors, such as we have described, either turn synchronically or stop. We therefore mention this property of the multiple transformer without, however, attaching any practical importance to this fourth special function.

5. On continuous current being supplied to the brushes, B, the apparatus turns, is excited, and triphased alternate currents are collected at C. Thus we have *a transformer of continuous currents into alternate triphased currents*. Of course any winding whatever of a continuous current dynamo, furnished with the three collecting rings can be made to act in the same way. M. Dolivo-Dobrowolsky, at the Frankfort Exhibition, used the drum-winding, taking the continuous current from accumulators and transforming it into triphased alternate currents working his little revolving field motors during the stoppages of the Lauffen transmission. In a recent paper to the *Société Internationale des Electriciens*, the writer of these articles used, for the same purpose, a small series continuous current dynamo constructed by M. Hillairet, with a Gramme ring furnished with three collecting rings for repeating the principal experiments relating to revolving fields and polyphased alternate currents.

This mode of transformation may be applied to certain special cases when, for instance, it is required to work from a great distance an electric motor that is not easy of access, that cannot easily be examined and attended to, and the sparks of which issuing from the collector entail a certain amount of trouble or inconvenience. The continuous current, when transformed into polyphased currents, can in such a case serve to work a revolving field motor without either collector or brushes, and, above all, without sparks.

6. The most important of the transformations which can be effected by means of the apparatus is unquestionably that of which we have now to speak. By sending into C triphased alternate currents, the apparatus is made to turn synchronically with the frequency of the alternating current, and continuous current is collected at B. The apparatus is a transformer of triphased alternate currents into continuous current. The mode of transformation is similar, but of a contrary nature, to that which we described when speaking of the fourth function of the multiple transformer. We can see that by connecting utilising apparatus at B, these latter will be traversed by continuous currents, and may be either motors, accumulators, electrolytic baths, &c., as required. We shall have occasion to describe an application of this kind, namely, the working of many little motors, made by M. Schuckert with his diphased alternate currents.

From what we have just said, we see that it is possible to conceive a great number of continuous current and polyphased alternate current motor generators, by suppressing those parts that are useless for certain special applications, and by giving the essential organs known arrangements combined in different ways. We have been careful to describe the principle only of these curious transformations, not entering into questions of priority which our present information will not enable us to decide, or even to study, with any degree of completeness. In a subsequent article we shall discuss the apparatus for producing, transforming and utilising *diphased* alternate currents, and we shall, in conclusion, endeavour to establish a comparison between these two systems and that of simple alternate currents.

E. H.

ERRATUM.—The motor of M. Dolivo-Dobrowolsky, illustrated on page 556 of last week's, should be described as of 100 H.P. and not 900 H.P.

NOTES.

Church Lighting.—The proposed new parish church of Swansea is, it is stated, to be lighted by electricity.

Mica.—Large quantities of mica are said to have been discovered near the town of Muldiva, Australia.

Electricity in Pittsburgh.—It is claimed that the electric power in the City of Pittsburgh, Pa., U.S.A., is equivalent to 13,000 H.P.

Electricity Act for Burmah.—It is officially announced that exercising his conferred powers the Chief Commissioner of Burmah has extended the Electricity Act to Upper Burmah.

Electric Lighting at Hastings.—An unsuccessful attempt has been made to reduce the cost of the electric lighting of the marine parade from the Queen's Hotel to Warrior Square, by lowering the candle-power. It is estimated that this piece of electric lighting costs £450 per annum.

Electricity in Switzerland.—At the end of 1890 there were 434 electric light installations in Switzerland, in which 68,368 incandescent and 1,068 arc lamps were employed. In addition, there were 34 plants in use at that time for the electrical transmission of energy.

Electric Lighting in Madrid.—Since it has become evident that at 1s. per unit, which is the price now fixed by the Madrileña Electric Light Company, electric lighting is cheaper than gas at 9s. per 1,000 cubic feet, there is a great movement in favour of electricity. The fact has been demonstrated in the Mercantile Club, of which the great majority of the merchants of Madrid are members. Their premises during the last two years were lighted by gas at an average cost of £850, and now that they are lighted by electricity the cost is less than £650.

The Royal Society.—The following papers were announced to be read yesterday before the Royal Society:—Prof. Ayrton, F.R.S., and H. Kilgour, "The Thermal Emissivity of Thin Wires in Air"; G. J. Burch, "On the Time-relations of the Excursions of the Capillary Electrometer."

Larne Lighting.—Owing to the electric lighting company having failed to fulfil the contract for lighting the town of Larne with electricity by the time agreed upon, the gas company were consulted recently. For the next week or so, until the work is completed, certain thoroughfares will be lit by gas, the cost of which is to be borne by the electric light company.

Electric Lighting in Mexico.—The electric lighting of two large dredgers engaged upon the new Mexican drainage canal (for which Messrs. Pearson and Son are the contractors), has been entrusted to Mr. A. H. Wood of Chesterfield House, Great Tower Street, E.C. The generating plant for each dredger, consists of one Marshall's fixed horizontal engine, capable of developing 12 brake H.P., and 1·5 unit compound wound dynamo, driven by means of a belt. There will be 37 16-C.P. lamps and 18 50-C.P. lamps on each dredger.

Electric Lighting at Hove.—The electric light committee of the Hove Board of Commissioners, report that in answer to their advertisement inviting tenders for the supply of electricity, communications had been received from several companies including the Brighton and Hove Electric Lighting Company, Limited, and Messrs. Crompton and Company, Limited. The committee recommend the board to enter into negotiations with Messrs. Crompton, as that firm alone had accepted the scheme adopted by the commissioners in its entirety. The committee also recommend that the services of an electrical engineer be obtained on the proposed contract and the carrying out of the work.

A New Thermo-Electric Battery.—An ingenious little thermo-electric battery has recently been perfected which presents the following features:—A small block made of a certain alloy has a small wire or a strip of nickel imbedded in it near each end; the alloy consists of antimony, three parts, and zinc, two parts. The wires project in a vertical direction from the horizontal top face of the block, and the end which is to be heated is protected from fusion by a casing made of iron. To form a battery, a number of these blocks are taken and joined in series, and they are so disposed that their cased ends can be heated to a high temperature without fusing the unprotected portions.

The "Ferranti Effect."—Our contemporary, *Industries*, states that they at one time thought that the Ferranti effect had something to do with mains of large electrostatic capacity, but during conversation recently with an electric engineer they found that their ideas are not shared by all. Referring to Dr. Fleming's paper, read before the Institution of Electrical Engineers, this engineer said: "I did not follow the paper, but the Ferranti effect was a very serious business." By questioning him gently they found that his idea of the Ferranti effect was burning up ten thousand pounds' worth of transformers at a time. This is rather hard on Mr. Ferranti. Burning up one transformer at a time is quite a common event, especially in America, where one eminent inventor has patented an arrangement which provides a flue for carrying off the products of combustion. Such insignificant phenomena cannot for a moment be dignified with the appellation of the Ferranti effect. Injuring large alternators by switching them into parallel when they are half a period out of step, produces a loss of a few hundred pounds or so at one time, and can therefore hardly be honoured with the full title; nothing less than a consumption of several thousand pounds' worth of material at one fell swoop should really be called a "Ferranti effect." Our contemporary admits that it is too bad to attach the name of one of the ablest electrical engineers to such a very undesirable phenomenon, but it is very unlikely that "effects" of such magnitude will occur again. It might, however, be a good plan to attach the names of engineers to disastrous results first produced by them, on the same principle that diseases are frequently called after their first discoverers. Most of our eminent electrical engineers could then have their celebrity largely increased.

The Electric Light in Greece.—The central station in Athens is now supplying current to 2,500 incandescent and 75 arc lamps.

The United States Navy.—The new cruisers, *Texas* and *Main*, for the U.S. Navy are being fitted with four electric fan blowers and four motors by the Arnold Electric Manufacturing Company, of Chester, Pa., U.S.A.

The Electric Tramway to the Breconshire Beacons.—The electric tramway to the Breconshire Beacons promises to become a great success. Matters in connection with the scheme are being pushed forward as rapidly as possible.

The Telephone as a Thief Catcher.—When inspecting the Johnstone Police Force last week, Captain Monro, Her Majesty's Inspector of Constabulary for Scotland, strongly advised the town council to adopt the telephone, as it was a great service to police authorities in the detection of crime, and many of the burghs in Scotland had now had the service introduced.

Overhead Electric Railways in the United States.—A new enterprise, with the title of the United States Rapid Transit Company, has been incorporated at Springfield, with a capital of $5,000,000. Its promotors propose to string enormous cables over the tops of the houses. On these will be rigged carriages, which will convey Chicagoans from point to point with inconceivable rapidity. The whole business will be driven by electricity.

Delay on the City and South London Railway.—The *St. James's Gazette* states that a serious delay occurred on the City and South London Electric Railway last Monday morning. Passengers at the Stockwell terminus were detained over half an hour. Two trains were in the station, each having their full complement of passengers. After waiting a considerable time, some of the passengers left the trains and proceeded to the City by another route.

Electric Lighting at Halifax.—At a meeting of the Halifax Town Council, held on Monday last week, Alderman Davis in referring to the adoption of the electric light in the town, said that although the profits from the gas works amounted to £6,000, the gas committee considered the question of electricity one of such importance that they advised the formation of an electric light committee. In the meantime it was decided that both the committee and the council should discuss the matter.

Electric Light in Brussels.—The Brussels municipal authorities have received six offers for lighting the streets by electricity. The following are the names of the firms:—Messrs. Ferranti, London; Crompton & Co, London: Siemens & Halske, of Berlin; India Rubber Company, of Silvertown; Compagnie Internationale d'Electricité, of Liege, and Schuckert & Co., of Nuremburg. Adjudication will be made as soon as the various tenders have been investigated by the technical committee.

Electric Lighting in Liverpool.—Referring to our note under this heading last week, we now understand that the work of lighting Messrs. Herwshsberg and Ellis's new premises, was carried out according to the specification, and under the superintendence of Mr. Thomas L. Miller, Assoc.M.Inst.C.E., 7, Tower Buildings, Water Street, Liverpool. The installation consists of a Crossley gas engine, fitted with their patent self-starter and capable of developing 26 horse-power at the brake, which drives a Tyne dynamo of the four-pole type, the current from which is led to the main switchboard (supplied by Messrs. Munroe's manufacturing company, Glasgow), and from thence passes through six double-pole switches, with double-pole cut-out to the various circuits throughout the building. In addition to the 140 glow lamps, the installation consists of 2-19 ampère arc lamps running in series; 2-10 ampère arc lamps running in parallel and in series with the 20 ampère mast head light; 2-5 ampère arc lamps for the doorways running in series, and 4-5 ampère arc lamps running in parallel and in series with a 20 ampère arc lamp fitted in a 16 inch projector, fixed in the turret and sending its rays through four windows over the city. The lamps are run from a 110 volt circuit.

The Electric Light in Hungary.—The large spirit factory of Messrs. Mittelman in the town of Arad, Hungary, is being fitted throughout with the electric light. The work is in the hands of Messrs. Ganz and Company.

Electric Lighting of Harrow.—At a meeting of the Harrow local board, it was decided that Messrs. Joel and Company be requested to quote prices for the electric lighting of Harrow, both by the arc and incandescent lamps.

Physical Society of Glasgow University.—At the ordinary meeting of this society held last week in the University, a paper was delivered by Mr. Malcolm Sutherland, electrician to Messrs. Denny and Brothers, Dumbarton, on the "Electric Lighting of Ships."

Provisional Order.—At a meeting last week, the St. George's Vestry consented to the grant by the Board of Trade to the County of London Electric Lighting Company, Limited, of a provisional order to supply electricity within the parish of St. George the Martyr, Southwark.

Dundee Factory Lighting.—The most important installation which has yet been introduced into any public work in Dundee, is that by Messrs. J. and A. D. Grimond, of Bow-bridge Works. It is said that this installation is one of the largest and covers a greater portion of ground than any other installation in Great Britain.

Society of Arts.—On Wednesday evening, November 18th, the opening address of the 138th Session of the Society was delivered by the Attorney-General (Sir Richard Webster, M.P.), Chairman of the council.

Telegraphs in the United States.—During the year ending June last, the Western Union Telegraph Company transmitted no less than 59,148,343 messages, being an increase of 3,269,581 messages as compared to the previous year. The company now possesses 715,591 miles of wires, being an increase of no less than 36,594 over the preceding year.

Electric Lighting in Newcastle.—The installation of the electric light which has just been introduced into the Assembly Rooms, Westgate Street, Newcastle, was tried for the first time on Wednesday night, last week, this formal function being discharged immediately prior to a concert which was held in the large ballroom. The lighting of the ballrooms has been completed in the brief space of ten days. The electricity is obtained from the Forth Banks works of the Newcastle and District Electric Lighting Company, Limited.

Electric Lighting at Brighton.—As the result of negotiations with the Brighton Electric Light Company, the Lighting Committee of the Town Council have presented a report recommending that £7,000 be paid to the company, for which sum the latter will be prepared to use their best endeavours to obtain a transfer to the corporation of their contracts and cease to supply electricity within the corporation's area of supply; to abandon their attempts to get further Parliamentary powers, and to cease supplying in municipal Brighton altogether on notice from the corporation; to take effect not earlier than December 31st, 1893.

Woodhouse and Rawson United.—The *Financial Times* of yesterday states that "The courage shown by the directors of Woodhouse and Rawson United in making an issue of new capital in face of the awkward balance-sheet presented to the shareholders last Friday is more strongly exemplified by the terms at which the new shares and stock are offered. Fully-paid ordinary shares are now quoted nominally 3 to $3\frac{1}{2}$, and those with £2 10s. paid, similar to those now offered at 5s. premium, stand in the market, so far as there is one for them, at $\frac{7}{8}$ to $1\frac{1}{2}$. The £5 preference shares, now offered at par, are nominally 3 to $3\frac{1}{2}$ in the market, and the debentures offered at par are quoted 78—80. Those who want Woodhouse and Rawson shares know where to get them more cheaply than by subscribing to this new issue."

The Electric Lighting at the Mansion House.—It is stated, that the installation of the electric light at the Mansion House will not be finished until the middle of next month.

Electric Light Installation at Birstall.—An extensive installation of electric lighting has just been completed at the Birstall Print Works by Messrs. Edison, Swan & Company, of Manchester. The current is generated by an Edison-Hopkinson dynamo, with a capacity of 105 volts, 180 ampères, and driven by a special horizontal condensing engine. Over 100 lamps are distributed over the colour-printing and engraving rooms and the mechanic's shop.

Proposed City Railways.—The City Commission of Sewers, on Tuesday last, gave instructions for the posting of notices in the City with respect to the proposed railway from Waterloo to the Mansion House, the extension of the Central London Railway from the Poultry to Liverpool Street, the construction of a line from Finsbury Park to Moorgate Street, and the Islington extension of the City and South London Railway.

Extension of Electric Lighting in Newcastle.—Even with the promised cheapening of gas by 2d. per 1,000 cubic feet, the Corporation is proceeding with the illumination of the leading thoroughfares by the electric light. The experiment, so far, is deemed very satisfactory, the brilliant lighting having been widely commended. At a meeting of the City Lighting Committee it was agreed to put up a 1,500 C.P. lamp at the opening to the Haymarket, opposite St. Thomas's Church.

Mr. Edison's Proposed Electric Railway.—Mr. Edison, in a recent interview with a member of the *New York Herald*, gave some vague particulars of a scheme of electric locomotion which, according to the imaginative reporter, is to solve the great problem of electric traction. Briefly, Mr. Edison proposes to use the track rails as a conductor. The power is to be transmitted, in the first instance, at 500 or 1,000 volts and to be received by a motor of proper voltage. This motor is to run a dynamo, the two together forming the familiar dynamo-motor combination for reducing direct currents. The currents from the secondary dynamo, under pressure of about 20 volts, are to be carried to the rail of the track, thence through the motor, thence through the other rail, thence returning to the dynamo. Each of these motor-dynamo plants is to give sufficient capacity to handle the business of, say approximately, one city block of the line; that is to say, on a street of heavy traffic enough current must be had from this secondary plant to supply five or six cars, and its capacity must therefore be in various plants from 50 to 150 H.P. The current flowing through each rail, in case there be the heavy traffic above described, will be, at a point near the secondary generating station, anywhere from 1,000 to 3,500, or even a larger number of ampères. A high rate of speed is to be obtained, and the system, it is stated, will be the cheapest known. This scheme is not approved by American electricians, and Prof. Elihu Thomson, in the *Electrical World*, says that he is inclined to let the reports go for what they are worth, and such statements coming from Mr. Edison are calculated to retard the growth of the industry, particularly as the schemes which he puts forward as solutions of the problem of street railway work have not received the beginning of a demonstration of their feasibility, a demonstration which is hardly likely ever to be made. Prof. Thomson is, on the whole, inclined to treat the matter as a piece of joking. Prof. Short and Mr. O. T. Crosby, however, contemplate the subject seriously, and give instances which show that Mr. Edison's method is by no means new. Mr. Crosby pertinently remarks that electric traction has been retarded by the absence of really good motor design—in which work Mr. Edison has not helped at all—and of general confidence in electrical machinery. As to Mr. Edison's great rate of speed, Mr. Crosby plainly states that the problem of high-speed electrical railway work does not demand a genius. It demands good railroading, good engineering, and plenty of money. Considering the lack of information, and the untrustworthiness of the whole scheme, it is surprising that so reputable a journal as the *Engineer* should discuss and attach so much importance to Mr. Edison's proposal.

Colliery Electric Lighting.—The electric light fitted up at Dumbreck Colliery, Kilsyth, by Messrs. Mavor and Coulson, of Glasgow, has proved most successful.

Crystal Palace Electrical Exhibition.—Mr. Musgrave Heaphy, C.E., has been appointed to supervise the various installations as far as fire risk is concerned during the forthcoming Electrical Exhibition at the Crystal Palace.

The Institution of Electrical Engineers.—On Thursday, November 26th, 1891, there will be a continuation of discussion on "Description of the Standard Volt and Ampère-meter used at the Ferry Works, Thames Ditton."

Electrically Lighted Omnibuses in Berlin.—It is said that the General Omnibus and Packet Company, Berlin, is now placing omnibuses fitted with the electric light in regular service in one district.

Electric Supply in Liverpool.—The Liverpool Electric Supply Company have secured the approval of the Health Committee to their plans for laying electric mains in Bold Street and Rotunda Place, opposite the Lyceum.

Electric Lighting in the City.—It is said that at the conclusion of the meeting of the Commissioners of Sewers at the Guildhall on Tuesday last, Colonel Haywood (the engineer) announced that he had just received a most important communication from the City of London Electric Lighting Company, intrusted with the carrying out of the street lighting in the City, praying for an extension of the time allotted them for fulfilling their contract. The letter in question was not read, as there were only a few members present, but the announcement gave rise to expressions of indignant surprise after the great delay that has occurred. The subject is likely to lead to an exceedingly lively debate at the next meeting of the Court a fortnight hence.

Electrical Storage.—A secondary battery has been quietly making its way in Paris for the past three years, and has now taken the lead in that city, where it is now in use storing the electric current for about 70,000 lamps. The manufacture is carried on by the Société Anonyme pour le Travail Electrique des Métaux, at their works at St Ouen, near Paris, where the present output of plates is at the rate of five tons per day. The capacity of the works, however, is a production of ten tons per day. In these accumulators the main objects sought are to increase both the working capacity and the durability, without increasing either their weight or cost. To this end the plates are made of a grid pattern, the square holes being filled in with lead having a very high degree of purity and porosity, which is the secret of the great efficiency attained. The ordinary plates made by the Société have a capacity of 10 ampère hours per kilo. of lead plates in the accumulator. They, however, produce other plates, which are specially made for traction purposes, and which possess the capacity of 19 ampère-hours per kilo. Another remarkable feature of these accumulators is the very high rate at which they can be charged and discharged, maintaining, at the same time, an efficiency in excess of anything hitherto attained. An example of this is afforded by the installation at the Hôtel Continental. In this instance there is a 110-volt battery arranged in 55 half-ton cells, the output of the battery in ordinary working amounting to 600 ampères. It is stated, however, that on an emergency this battery has been found capable not only of discharging at twice that rate, or 1,200 ampères, but of doing so without any appreciable fall in the voltage and without any detriment to the plates. The largest installation in connection with which these accumulators are used in Paris is that of M. Popp, in which case about 25,000 lamps of 16 candle-power each are taking their current from them. The engines and dynamos at this latter station used for charging the batteries cease running at about 4 p.m. daily, the batteries carrying the entire load from that hour until the next morning. Besides being in use for the supply of some 70,000 lamps in Paris, these accumulators have been adopted in the Navy by the French Government after severe tests.

Electricity in Coal Mining.—One of the latest American collieries to adopt electric coal mining machines is the O'Neil and Peterson mine at Bunola, on the Monongahela River. The plant has been put down by the Michaelis Electric Coal Mining Machine Company, of Pittsburgh, U.S.A. Each machine is capable of mining 65 tons of coal per day.

County Council and Electric Lighting.—Referring to our note last week regarding the long delay on the part of the County Council in returning meters sent them to be tested, it appears that the writer of the letter we mentioned, has quite misunderstood the conversation he had with the representative of the company, to which he made reference. Another letter appeared on Wednesday last, in the *Times*, on the same subject, from Mr. Gay, the manager of the House-to-House Electric Light Supply Company, who says that the statements he made to the complainant were to the following effect:—"We have had considerable trouble with meters generally, as some six or seven months since over 100 meters were placed on order, but, in consequence of certain alterations in the design being required to meet the approval of the Board of Trade, none of them were delivered until some three weeks or a month since, when a portion of the meters arrived, the whole of which were sent at once to the County Council for certification." In Mr. Gay's opinion, the County Council are doing all in their power to meet the requirements of the public and the supply companies.

NEW COMPANIES REGISTERED.

Dalziel's News Agency of America, Limited.—Capital £100,000 in £10 shares. Objects: To acquire from Dalziel's Cable News Agency, Limited, the business hitherto carried on by them within the limits of the United States of America; to carry on the said business; and to carry on within the limits aforesaid the businesses of advertising agents, newspaper proprietors, printers, publishers, newsagents and stationers, and of a telephone, telegraph and electric light, heat and power supply and pneumatic dispatch company. Signatories: D. Dalziel, 222, Strand, 10 shares; W. C. Hallett, 7, St. Martin's Place, W.C., 50 shares; H. F. Jackson, 31, Harrington Gardens, S.W., electrical engineer, 10 shares; W. L. W. Whittaker, 65, Warwick Road, Maida Vale, W., 10 shares; G. A. Kerr, 85, Queen Victoria Street, E.C., 1 share; G. F. Mogg, 24, Lebanon Gardens, Wandsworth, S.W., 1 share; J. T. Glass, 60, Ashmore Road, St. Peter's Park, W., 1 share. The number of directors is not to be less than two nor more than seven, the first being D. Dalziel (managing director), W. C. Hallett, H. F. Jackson and H. King. Qualification £100. Remuneration £150 each per annum and a percentage of the profits. Registered on the 14th inst. by Messrs. Burton, Yeates and Hart, 23, Surrey Street, W.C.

Railway Electrical Fog-Signal Syndicate, Limited.—Capital, £25,000 in £1 shares. Objects: To acquire certain patents, No. 18,747, of 1889, and No. 14,181, of 1890, granted to W. Andrews, for improvements in electrical fog-signals; to adopt an agreement, dated October 27th, 1891, between W. Andrews, of the one part, and J. Press, jun., of the other part, for that purpose; to carry on the business of electrical engineers and contractors, manufacturers of, and dealers in, electrical apparatus, and the business of an electric light company in all its branches. Signatories (with 1 share each): A. Moore and J. Lewin, Victoria Road, Netherfield, Notts; W. Langsdale, 156, Radford Boulevard, Nottingham; S. P. Derbyshire, Wheeler Gate, Nottingham; M. Gregory, 10, Colwick Road, West Bridgford, Nottingham; G. Tutin, Station Road, Beeston, Notts; F. G. Bedells, Nottingham. The number of directors is not to be less than three nor more than nine, the first to be elected by the subscribers. Qualification, £250; remuneration, £500 per annum. Registered on the 12th inst. by S. G. Warner, 6, Quality Court, Chancery Lane, W.C.

Isle of Wight Electric Lighting Company, Limited. Capital £1,000 in £1 shares. Objects: To carry on the business of electricians, mechanical and electrical engineers, manufacturers, workers and dealers in electricity, motive power and light. Signatories (with one share each): F. R. Reeves, Mansion House Buildings, E.C., electrical engineer; J. Shields, 70, Cressingham Road, Lewisham; W. A. Nelson, Leonards Terrace, Montague Road, Leytonstone; W. P. Adams, Springwell, Barnes; H. J. Dowsing, The Cedars, Manor Park; R. C. Noble, 73, Clarence Street, Islington, N.; R. Dand, 98, Grafton Street. The regulations of Table A mainly apply. Registered 12th inst. by Deacon & Co., 4, St. Mary Axe, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Wyndham Electric Light Company, Limited.—The statutory return of this company, made up to the 2nd inst. was filed on the 10th inst. The nominal capital is £1,500 in £1 shares, 585 of which have been taken up, 100 issued as fully paid, 15s. per share called upon the remainder and £200 paid (including £19 10s. paid in advance of calls), leaving £183 5s. unpaid. Office, Old Bank Chambers, Market Square, Pontypridd, Glamorgan.

City of London Electric Lighting Company, Limited.—The statutory return of this company, made up to the 29th ult., was filed on the 12th inst. The nominal capital is £800,000 dividend into 40,000 ordinary and 40,000 Preference shares of £10 each; 30,152 ordinary shares have been taken up and upon 1,500 the full amount has been called and paid. Upon the remaining 28,652, £4 per share has been called and paid, the calls paid amounting to £129,608. Registered office, 1 and 2, Great Winchester Street, London, E.C.

City of Waterford Electric Supply Company, Limited.—The offices of the above-named company are situate at 11, Queen Victoria Street, E.C. (filed 12th inst.)

East London Electric Supply Company, Limited.—The registered offices of this company are situate at 11, Queen Victoria Street, E.C.

St. John's, Hampstead, Electric Supply Company, Limited.—The registered office of this company is situate at 11, Queen Victoria Street, E.C.

BUSINESS NOTICES, &c.

Woodhouse and Rawson.—Messrs. Woodhouse and Rawson have just finished a fine installation at Messrs. Colson & Co.'s, 33, High Street, Exeter. There are 59 32-C.P. lamps erected, and the shop is now considered the best lighted in Exeter. The current is supplied from the Electric Light Works in the town. They are also putting down a 50-light plant in a new printing premises, to be driven by an Otto gas engine, and a 70-light plant in a new house, at Ashton, near Chudleigh. The work is being carried out by Mr. E. Kenealy, their representative in Exeter.

New Business.—Mr. R. W. Paul, who was formerly with Messrs. Elliott Bros., has started in business as an Electrician and Scientific Instrument Maker, at 44, Hatton Garden, E.C. Having worked for several years as journeyman instrument maker, besides having had a technical training and experience in the adjustment of apparatus, Mr. Paul intends to devote special attention to testing and measuring instruments for commercial and laboratory work. He took the Honours' Medal of the City Guilds in 1887, for electrical instrument making.

Henley's Telegraph Works Company.—We have received from W. T. Henley's Telegraph Company a printed price list of their electric light cables and wires, also vulcanised and unvulcanised India-rubber, and other jointing materials. Amongst other information given, we notice some simple instructions and rules for jointing, and we think the list will be of value to Messrs. Henley's customers and the electrical trade generally.

Laing, Wharton and Down.—We are informed that a disastrous fire occurred last Tuesday night at Messrs. Laing, Wharton and Down's works. The firm are, however, making arrangements which will enable them to execute orders as promptly as ever if customers will give them a few days' grace.

Drake and Gorham.—The installation of the electric light at Felsted, which has just been completed by this firm, is of special interest, as it is the first public school in the country to be so lighted. Messrs. Drake and Gorham have been occupied at Felsted since July.

CITY NOTES.

Woodhouse and Rawson United.

THE annual general meeting of Woodhouse and Rawson United, Limited, was held on Friday last at the Cannon Street Hotel, under the presidency of Sir Rawson W. Rawson, K.C.M.G., C.B., chairman of the company.

The CHAIRMAN said: Gentlemen, I have much pleasure in rising to render to you an account of our stewardship during the past year, the second year of our existence. Considering the extraordinary financial crisis that has occurred, and the general commercial depression which ensued, we trust that you will find the results of the operations of the company during that period eminently satisfactory. Looking at the profit and loss account you will find the following results. Deducting from both sides of the account the amount of £16,000, brought forward from the previous year, you will find that the total earnings of the company amounts to £87,000. Out of that we have provided for all our current expenses, we have written off what we consider a sufficient amount in the reduction of the value of our patents, we have paid the interest due on our debentures, and we have written off £10,500 for extraordinary expenses, which might fairly have been distributed over several years. We have also left a balance of £35,000 to meet our dividends—being 15 per cent. on the ordinary shares, and 8 per cent. on the preference shares. This leaves a balance of £4,600 applicable to such purposes as the shareholders and directors think fit. When we add to that the £10,000 of extraordinary expenditure, our earnings during the year were £15,000 above our current expenses; that is, of course, including the guaranteed interest of 15 per cent. on the ordinary shares and the 8 per cent. on the preference shares. That amount is also without trenching upon the £16,000 carried forward from the previous year. Now, gentlemen, the directors hold, and we trust that you do also hold, that in a year such as that through which we have passed, the result has been very satisfactory. One of the chief features of the business is to avail itself of new inventions, to utilise the patents which it possesses, and also to interest the public with new inventions connected chiefly with electricity. Well, this has been a year in which the public have not been disposed to enter upon new undertakings, and consequently we have had but very little encouragement. We have had a number of proposals of different kinds which we have not thought it right to accept, and yet, in spite of all this, we have made, as I have shown you, a clear profit of nearly £35,000, which is a very satisfactory result on the operations of the company. Perhaps the most useful course that I can adopt is to just run through the balance-sheet and profit and loss account, and to explain any matters which it may appear necessary, or which might require an explanation, or upon which you are likely to seek information. You will see in the balance-sheet that we have reduced the mortgages on freehold property by £3,000. The sundry creditors stand at £8,000 less. We have swept away the whole of the guaranteed funds which stood in the last account at £75,000. Then you will find inserted in these accounts for the first time a reserve of £25,000, and a pension fund amounting to £1,065 for our employees. Turning to the credit side, you will notice that there is an increase in the item of freehold premises of £1,200, which is caused by the building and improved engine-power erected at the Cadby Hall, of which an account is given in the report, and also sundry improvements in the Kidsgrove property, which was taken over just at the commencement of this year, and which necessitated a certain delay. There is a small increase under the head of leasehold premises, but that is easily explained, the United Company having acquired new works. Having made a new organisation and extended its business, I may say, throughout the world—in Australia, South Africa, and in other parts—we have necessarily had to make a large outlay on our works for plant, on our supply stations for stock, on our installation and contract work for the works in progress. In fact, what did we ask money for but to extend our business? We have extended it, and the explanation of the increase in these items is simply that we have extended our legitimate operations connected with our trading and manufacturing pursuits. The next item is the moiety of special expenditure on advertising, repayable by instalments. You can well understand that at the commencement of our operations it was necessary to advertise largely. It was a necessity because we were extending our business, and we had to inform the public at large of the nature and extent of the business we were prepared to undertake. We have, therefore, prepared a catalogue—and to my mind it is certainly the best, the most complete, and most exhaustive one on electrical and engineering subjects, I believe I may safely say, in the world. It is generally admitted to be so, and I may tell you we are proud of it. We feel confident that this volume is calculated to improve very much the standing and credit of the company, and will also tend to extend our business throughout the different parts of the world. The printing and advertising of this catalogue was a very great expense, and we have thought it right to divide the whole of the expenses of this over the past and the present year, and not to spread it over three, four, or five years as we might do. The result of the "work" is, of course, prospective, but the expense is immediate. But we think it better to meet as far as possible all our expenditure as it arises, and as our earnings are sufficient to cover it, we have charged it in this instance half to last year's operations, and we intend to charge the other half to the present year's. In the next item of patent and patent rights there is an apparent increase of £10,000. This has not arisen from any material addition to the patents that we possess, but to the completion of the original purchase of two of the Woodhouse and Rawson subsidiary companies. The completion of the purchase, which was delayed for awhile for two reasons, was effected last year, and, of course, we take over their patent and their business, and so forth, according to the original arrangement. It is not that we have enhanced or added to the value of our patents except by the completion of our original contract with these two companies. With regard to sundry investments, if you compare the first balance-sheet with this, you will find in the first only £11,000 under this head, but you must take into account that there was a sum of £75,000 which was reserved to repay Woodhouse and Rawson, Limited, so that our investments in the past year were £85,000, and that figures now at £119,000. I should be very glad to show you exactly what these investments consist of, but it would be opposed to your interests. All I can say is this, that the valuation of them have been taken at the lowest and most reasonable figure. They are not speculative investments, they are investments of which you have perfect cognisance. All I can say to you is that last year the investments which stood upon our balance-sheet were parted with at a higher price than that in which they stood in our balance-sheet. We shall dispose of these investments on equally advantageous terms as we did our investments in the previous year. The managing director authorises me to say to you that we have already disposed of some of our investments, and every one of them at a price above what they were put down in the balance-sheet. You will notice that the sundry creditors have increased £30,000; however, that is guaranteed. As our business extends our debtors must necessarily extend. The first item I will refer to in the profit and loss account is the salaries. Your very able managing director, Mr. Frederick Rawson, suffers here, as his remuneration depends upon the surplus profits after the guaranteed dividends have been paid. There is a large increase under the head of debenture interest. This is due to the repayment of the debentures issued during last year. With regard to the writing off of patents, we have applied £4,156 to that purpose, upon the principle that we consider that if we write off one-fourteenth it would be sufficient for the purpose. The foreign patents are not limited to 14 years, but the English patents are. Taking, therefore, the life of a patent as 14 years, we consider that if we deduct each year one-fourteenth they would be gradually written off. Last year we applied £7,400 for that purpose. We have not applied so much this year, but we make the amount up to one-seventh in the two years, so that we have written off £11,500 from our patents, and we shall go on writing off at the same rate until our patents have expired. For some of our patents, however, we have paid nothing at all, and they do not stand in our books as possessing any value, and yet some of them possess a large value. With regard to another class of our patents, we only charge the cost of registration, and therefore, taking these circumstances into account, we consider, and I hope you will consider, that to deduct every year one-fourteenth a year from our patents is a reasonable calculation, and will bring us at the end of these 14 years, as regards these patents, to a blank sheet as a claim against the company. The next item is income tax for 1890 and 1891. Well, of course, the increase for 1891 is a legitimate charge. The reason the income tax for 1890 is introduced into this account is on account of our not knowing the amount last year in time to display it in the account. There was a dispute between the officers of the company and the Inland Revenue officers as to the amount for which the company was liable. That was now settled, and consequently two years were charged in these accounts. The mortgage debentures redemption account is explained by the sum paid to the holders of debentures of 6 per cent. for the redemption of the 6 per cent. debentures and the acceptance of debentures at $5\frac{1}{2}$ per cent. The next item consists of preliminary expenses. It was impossible to explain them in detail. Last year it was placed to a general charge, but this year it was considered proper to wipe off the whole charge, and for that reason it figured in the accounts. If it had been entered into last year's accounts it would have diminished the profits of that year, and increased the profits of this year. The Cadby Hall removal of £2,000 is part of the estimated cost of the removal of our business from the one block in which it existed before we leased into the new block. It is partly the loss occasioned by the shifting of machinery, &c., into the new buildings, which the manager estimates as at least £2,000. On the other side of the balance-sheet we find that the gross profit is not as much as it was last year, but it is impossible to be blind to the fact of the very different circumstances of this year to the preceding one, and the opportunities possessed by the board of making profits. The balance of interest is some £3,000 more. We also have an item of rent derived from the West Kensington leasehold, which did not appear in the other account. Premium on shares and transfer fees remain stationary. Well then, gentlemen, the profit and loss account shows a profit carried to the balance-sheet of £51,000 odd. We have already paid an interim dividend which absorbed £14,000. We propose now to carry £10,000 to reserve and to carry forward £9,000 to next year. I trust you will think my explanation satisfactory of our work during the year, and that you will accept this report and the balance-sheet. Our managing director points out to me that our reserve now amounts to £45,000, which is more than enough to secure our dividends for next year. There is one point on which I personally feel a great interest and desire to speak about. That is the refusal of the Stock Exchange to grant a quotation. I wish to say that Lord Aberdare promised it as far as he could, and I did the same. In all my communications with the shareholders I have stated my belief that so far as I knew there was nothing to prevent our having this quotation. I had full justification for that. Our papers, after sundry references and considerable delays required by the committee of the Stock Exchange, were pronounced to be in order, and we had therefore every reason to suppose that we should receive our quotation. The only cause of the delay is that their voluminous papers took some time to go through. Three weeks before the quotation was refused we had the most reasonable expectations, from parties who occupied the highest positions in the Stock Exchange, that the quotation would be granted. The refusal took us as an entire surprise. We had not the least knowledge of the cause of the refusal. The committee of the Stock Exchange is autocratic, and does not give its reasons. It will be useless for us to ask them. The only surmise that we can form is that until the old Woodhouse and Rawson limited companies are wound up the Stock Exchange will not give us a quotation. They have granted us a day of settlement. We are given to understand that, after a reasonable delay, if we again apply, we might get it. I hope you will allow us to use our own discretion as to when is the proper time to apply for it. My own impression is that we should not apply for it until these companies are wound up, and we stand upon our own legs. With regard to this matter, I can assure you I have acquired an experience which will make me very cautious of holding out expectations which depend upon third parties. Now, gentlemen, with regard to the report. I am able to speak with the greatest satisfaction of the very great improvement that has been made at the West Kensington Works in the erection of the new block of buildings, and of the new engine-house. This will enable us to undertake a class of business which is likely to prove highly profitable. This new block will enable us to undertake on a larger scale the manufacture of mechanical apparatus, such as type-writers, and articles of that kind requiring great delicacy in construction. We have at present a contract for one whole floor of that building, a very extensive floor that will enable us to turn out many thousands of machines. We have another contract, which we hope in a few weeks to commence upon, of a similar character. We look, therefore, to a considerable extension both of business and of profit in that new block. With regard to the Kidsgrove works, we only entered into possession at the commencement of last year. It was a business that required considerable improvement in many ways, but all that had been accomplished now, and we expect with the coming year very different results from the Union Foundry at Kidsgrove. One of the objects of our acquiring this Union Foundry was this: We possessed the means of working all electrical apparatus of a small character, such as switches and a variety of things of that kind, but we had no works before we acquired the Kidsgrove, on which we could on a large scale manufacture dynamos and engines peculiar to electrical purposes, and could introduce new inventions —specialities, as I have called them. We hope, therefore, before we meet again, that we shall be able to report to you that we have established a sound and profitable business in that establishment. With regard to the supply department, that is going on very satisfactorily. There was necessarily during the year of which I am now treating a large expenditure in this department; to bring our stocks up to the required amount we have to maintain a large variety of different articles which are required by our different customers from all parts of the world, but the large expenditure in that direction last year will not be necessary in future years. We have attained now a degree of completeness in that department which will not necessitate any large future outlay. With regard to the installation department, we have every reason to be satisfied with the result obtained there. The character of our work, I may say, is such as to do us credit, and to secure to us the confidence of our employers. A very important matter is that with regard to the Epstein accumulator. I hope you will consider that it is a proof of the discretion of the board that out of the many inventions which we have had under our examination and test we have not plunged into the purchase of any that we were not satisfied was sure to yield us a profitable return. With regard to the Epstein accumulator, we have had it under our observation and test for two years, and the result is as satisfactory as we or you could possibly wish. We did not enter into any complication with regard to the accumulator until we were satisfied that it was most efficient, and that it opened up a new field for traction purposes, and that with efficiency and economy it was superior to anything that existed. We also satisfied ourselves that we were perfectly secured with regard to the patents in connection with it. We have had the authority of four or five of the most eminent agents and leading counsel to satisfy us before we entered into any arrangement with the Epstein Company. We believe we have a most valuable property in that accumulator, and we are carrying on its manufacture in our own buildings at a substantial profit. As I said before, I do not like promising or undertaking anything, but I may conscientiously say that the report and balance-sheet gives you an unexaggerated and fair statement of what we have done, and I may say that I have every reason to expect that our next year will be as good as the past or even better. We have good reason to suppose so. This being so, I hope you will be satisfied with what the board has done, and will justify it by the acceptance of the report and balance-sheet. I shall be happy to answer any questions that any shareholder desires to put to me. It only now remains for me to move that the directors' report and statement of accounts be received and adopted.

Mr. Philip Rawson seconded the chairman's motion.

Mr. Dixon quarrelled with the small amount put aside for the depreciation of the patents. He thought also that the £119,000 locked up in investment was not conducive to the prosperity of the company. It was a pity, too, that the shareholders were not allowed to see in what securities the directors had invested their money. He argued that it was a proprietor's right to know what their money was invested in. In conclusion, he moved as an amendment to the chairman's motion that the meeting be adjourned for a fortnight to give the directors an opportunity of reviewing the accounts.

Mr. Burbury seconded the motion, and in doing so said it seemed to him that it would be very much more to the interest of the company if a larger amount was carried forward and less was divided amongst the shareholders.

Mr. Griffiths thought it would be more satisfactory if certificates were obtained from the heads of each department.

Mr. Peake observed that it was only reasonable for the shareholders to wish to know what investments were held by the company. He held shares in a similar company to this, and although that company did not publish a list of its securities, yet it allowed the shareholders to inspect the list.

Mr. Bacon said when he first saw the prospectus of this company he felt that it would be a profitable concern; although it might be called to a certain extent speculative, yet it was only speculative on what he deemed solid grounds, and therefore he became a shareholder in the concern. He did not see what advantage the shareholders would gain by not passing the accounts. He thought, however, that the directors would have acted more wisely if they had written off the same amount as last year. In conclusion, he hoped the directors would take this into account next year.

Mr. Frederick Rawson, managing director, replying for the chairman, said the company had annually a large number of patents taken out by their staff. These patents were put in the balance-sheet at the mere cost of registration. Therefore from time to time the company's patents were becoming more valuable, though, as a matter of fact, they were gradually getting written off at the rate of one-fourteenth a year. The goodwill of the company was shown by the large dividends that had been paid. His advice would be, when the reserve got large enough, to write off the goodwill altogether. He might inform the shareholders that his instructions to the auditors were to cut down everything as low as it could be cut down. With regard to the extension of business, of course they must not expect those businesses to pay for the first year. They had written off every penny that had been expended in the establishment of new businesses. Speaking of the investments, he said they had given one shareholder facilities to see them, and the board had no objection to Mr. Peake doing the same, but they did not want anyone to see these investments for mere Stock Exchange purposes, which would have the effect of damaging the shares in the market. With regard to the locking up of stock, when he first saw the figures he said, "That won't do," but he ascertained that there was no dead stock. By that he meant stock that was antiquated. One good thing in extending their business was that people could come to the company and get what they wanted without having to wait for it. The idea mentioned by a shareholder of making the heads of departments responsible to the shareholders and giving certificates was a good one. In conclusion, he said they were only on the eve of what they believed would be an immense extension of electrical work, and if they were to be in the van of that extension they must spend largely on all sorts of new things, and keep themselves to the front.

The Chairman then put the amendment to the meeting, and it was lost by a large majority, only four voting for it.

The substantive resolution was then put and carried.

The retiring directors, Mr. Samuel Pope, Q.C., and Mr. Philip Rawson, were unanimously re-elected, and the auditors, Messrs. Jackson, Pixley, Husey and Co., reappointed.

The proceedings then terminated with a vote of thanks to the chairman, and other directors.

The West India and Panama Telegraph Company, Limited.

The twenty-ninth ordinary general meeting of this company was held at Winchester House on Tuesday last, Mr. C. W. Earle presiding.

The Secretary (Mr. R. T. Brown) having read the notice convening the meeting, also the minutes of the previous meeting,

The Chairman said that the report dealt with a period which he was afraid was not very prosperous to the West Indian commerce; at any rate, it was not nearly so good as the corresponding period of the year 1890, judging from their traffic receipts, and he thought they could not have a better barometer of the commercial doings of a country like the West Indies, where there was no Stock Exchange speculation like there was in New York, and, fortunately, no revolutions, as in South America. He thought that in such a country as that the traffic receipts formed a very good test of the business the company was doing. Before the operations of the French cable in their territory took place—which was the beginning of June—the decrease in comparison with the previous year amounted to 10 per cent., and he presumed that decrease was owing to a bad sugar crop; but perhaps Sir George Chambers would correct him if he was wrong on that point. The whole decrease in their receipts for the half-year amounted to £4,710. As a set-off against that loss they had a saving of £1,800 in expenses, and the balance of £22,773 to deal with, against a balance of £25,681 in the corresponding period of the year before, making a net deficit, altogether, of £2,910. They had placed £2,000 of that sum to the reserve fund, and they proposed, with the shareholders' sanction, to pay the dividends upon the preference shares, and to pay 1s. per share, free of income tax, to the ordinary shareholders. The set-off of £1,800 was attributable to the reduction in cable repairs. They had the good fortune to have only seven interruptions against twelve in the corresponding period, and they expended in repairing that interruption 44 knots against an expenditure of 72 in the corresponding period. If it had not been for the larger cost of cables this year, that reduction in expenditure would have been very much more important; but, as they all knew, iron and copper, and especially gutta-percha and wages, made a great rise about a year ago, and the result of it was that their cables cost when they were got out to the West Indies some 40 per cent. more than they had done 8 years before. He did not intend to take up their time by making a close analysis of the debit side of the revenue account; some items were rather larger than they were in the corresponding period, and some were rather less. On the whole, there was a balance of £200 against the company, and that was caused by the incidence of allowing small sums to various clerks, which was likely to be set right by the next time they presented an account. He next referred to what they would doubtless say was the most important part of the report, namely, that which treated with the competition that had appeared in their system. The shareholders had been informed from time to time of the approach of this competitive cable. He thought the first time the board had to apprise them of the possibility of this danger was in 1887, when the then Minister of Posts and Telegraphs in France brought in a Bill in the Chamber of Deputies to grant a guarantee of £40,000 a-year to a line of cables between North and South America, touching the French colonies and Guadeloupe, Martinique, and Cayenne on its way. The Chamber of Deputies threw out the Bill, he supposed because they did not see what interest France as a nation had in a line connecting two foreign countries on the other side of the Atlantic, and the project then appeared to drop, but in 1888 a French company, which certainly had not that formidable backing of £40,000 of the French Government behind it, and was therefore a less serious competitor, had laid a cable from Cuba to San Domingo and Venezuela, and, as announced in the report of the West India and Panama Company of April, last year, the French Company had had transferred to itself the subsidy hitherto paid to the West Indian Company by the Government of Martinique. It was thus seen that the French Company was preparing to compete with them for Guadeloupe and Martinique, where they had been established for more than 20 years. This line was opened early in June last; there had been no previous intimation of the tariff at which it was intended to open, and as the rates on the Venezuela cables which had been in operation some time were higher than the West India and Panama rates, mile for mile, they did not suppose that their rivals would adopt the ruinous policy of working below these rates, which had been found so inadequate after a very long experience. The Chairman supposed this was done for objects of their own, probably in order to get the French subsidies. They opened a tariff at Guadeloupe and Martinique at 2s. below the tariff which the West India Company had been charging, and the latter company deeming it inexpedient to prevent a diversion of the traffic and put the English colonies on as favourable terms as the French colonies, made considerable reductions. The result had been a considerable decrease in the revenue, but they must not attribute all the decrease to their traffics, as they were showing the effect of competition. The directors had made calculations of how much of the loss incurred was owing to competition, and how much was due to a natural loss of traffic; and it would appear that more than half of the loss that they had hitherto sustained was attributable to a decline in traffic; they were sending fewer words at the present rate than they did at the higher rates, and the chairman therefore hoped it was a very exceptional position. It was difficult to imagine a competition which was less justifiable from the point of view of what was to be earned. They had proved by the experience of many years that there was not traffic enough in the West Indies to support one company properly, and the appearance of another in the field, where the telegraph service had always been carried on at less than cost price, could only be disastrous to the new comers, costly to the West Indian Company, and in the long run disadvantageous to the public. He suspected that their competitors were beginning to find that West Indian telegraphy was no business in which to make fortunes. The new company had already two cables broken down, one of which was only laid a few weeks ago to the north of Brazil, and as far as he knew there was no means on the spot of repairing them. The short experience they had gained was somewhat discouraging. However that might be, the West Indian Company were in for a competition; it was not one of their seeking, but had been forced upon them and they must go through with it because there was no other course open to them. They were better prepared for it than their adversaries; the West Indian lines were duplicated, and they also had ships ready to repair break-downs, but the other Company were depending upon single cables and had no ships. By the shareholders wise provision and self-denial, a fair reserve had been established to meet possible contingencies, and though they must suffer in their revenue whilst the contest lasted, they hoped that their losses would not continue to be so severe as the present traffic returns indicated. The chairman said that they had just had the traffic return from the West Indies for the last fortnight which was very much more favourable and was very satisfactory. He had been informed that the next year's crop of sugar would show a good harvest. He had now only to ask the shareholders to give the board while in this difficulty, the confidence which they had enjoyed for fifteen years, and to remember that in their discussions it was not wise to hold a counsel of war with open doors in the way the meetings had to be held.

He then proposed "that the directors report and accounts to the 30th June, 1891, submitted to the meeting be received and adopted, and that as recommended by the board payments be made of 6s. per share on the first preference, 6s. per share on the second preference and 1s. per share on the ordinary shares.

The resolution was seconded by Mr. William Ford, who said he believed the company was never in a better position to meet the adverse interests of the company, and they must in the long run succeed; they had got their repairing ships, and in the reserve they had the money too. The national sentiment in which the French cable had its origin was all very well in its way, but the national sentiment would not earn dividends on capital. He was perfectly satisfied that the new cable was as commercially unnecessary as he believed it would prove unprofitable.

Sir George Chambers said that attention having been drawn to his name he had great pleasure in stating that what the chairman had said about the sugar crop was most strictly accurate, and that the decline in revenue might be attributed entirely to the bad weather which was experienced throughout the West Indies, and because the crops in many instances had been less than half what they had previously been. They had before them prospects of more abundant crops than ever, and he hoped they might see the return of those figures. He hoped that when they met again they would receive a more satisfactory account than the chairman had placed before them on this occasion.

Several shareholders spoke regarding the accounts, also with reference to the smallness of the dividend on the ordinary shares.

Mr. Griffiths (a shareholder) stated that he somewhat sympathised with the remarks as to the effect that the dividend was not larger this year, but he thought the policy of the board was a sound one in preparing for the competition and heavy repairs which they had to meet.

The Chairman, replying to the remarks of the shareholders, said that he could assure them that the question as to how they were to deal with the balance this year had caused them very great anxiety. They had debated the question from every point of view, taking into account the repairs to cables and falling off in traffic, which he hoped was not going to be so serious as it was at the early part of the half-year.

The report was then carried unanimously, and a vote of thanks to the chairman and directors terminated the proceedings.

The Swan United Electric Light Company, Limited.

The Directors' ninth annual report for the year ending September, 30th, 1891, state that after paying all current charges, and making due allowance for depreciation, there is a credit balance of £47,490 11s. 2d. The directors recommend that out of this balance a dividend of 11 per cent. for the year be declared; an interim dividend at the rate of six per cent. per annum, amounting to £11,104 0s. 5d., has already been paid in respect to the first half of the year; the balance of the 11 per cent. for the entire year to be distributed in accordance with clause 77 of the articles of association, and to be payable on the 1st December, 1891. This will absorb £28,376 6s. 11d., and leave £8,010 3s. 10d. to be carried forward. The decision of the Supreme Court at Leipsic, in the patent cases which the Allgemeine Electricitäts Gesellschaft brought against the company and their agents, has been given in favour of the company. The directors are now engaged in the consideration of the best way to take advantage of the favourable position thus created in Germany. The Compagnie Générale des Lampes Incandescentes in Paris have been in litigation as to their patents throughout the year. The experts, to whom the court referred the case, have not yet rendered their report to the judges, and until this is completed the court cannot adjudicate on the case. The Compagnie Générale, does a considerable amount of business, but competition is very keen on the Continent, and the selling price of the lamps is much reduced. The director who retires by rotation is Mr. J. W. Swan, who, being eligible, will offer himself for re-election. Messrs. Welton, Jones & Co., the auditors, will also retire, and will offer themselves for re-election.

Morecambe Electric Light and Power Company, Limited.

The first statutory meeting of the shareholders of the above company was held, on Monday evening last, at the offices, Morecambe. Mr. G. R. Snowden presided. The secretary read a statement of the society's affairs, which was approved; and the company's engineer attended with plans showing the position of the central station and the main cables to be laid for supply. The provisional directors were unanimously re-elected, with power to add to their number. The appointment of Mr. J. Duff as auditor was confirmed.

Blackpool Electric Tramway Company.

The annual report of the Blackpool Electric Tramway Company has been issued. The available profits amount to £3,234, and the directors recommend a dividend of 7½ per cent., absorbing £1,500, and that another £1,500 be added to the reserve fund, making it £6,000. The number of passengers carried during the year was 933,652. Messrs. Horsfall, Bickerstaffe, and Broadbent are the retiring directors. The total receipts were £7,200.

Woodhouse and Rawson United.—The directors of Woodhouse and Rawson United, Limited, invite applications for the subscription of the following capital:—10,000 ordinary shares of £5 each, being the balance of 60,000 shares; 13,000 preference shares of £5 each; £50,000 5½ per cent. 1891 debenture stocks. The debenture stock is redeemable in ten years at £105, being 5 per cent. premium, or at an earlier date if with the consent of two-thirds of the holders of the stock. The directors conclude by saying that they are able to state that the outlook for the company continues to be of the same satisfactory character.

The District Messenger Service and News Company, Limited.—This company, which was incorporated June, 1890, is now issuing £20,000 new capital, in 400 8 per cent. first mortgage debentures of £50 each. £10 payable on application, and the balance on allotment.

TRAFFIC RECEIPTS.

The City and South London Railway Company. Traffic receipts for the past week amounted to £819.

The West India and Panama Telegraph Company. The receipts of the West India and Panama Telegraph Company for the two weeks ended November 15th, show a decrease of £298 as compared with the corresponding period.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Nov. 12th.)	Closing Quotation. (Nov. 19th.)	Business done during week ending (Nov. 19th, 1891.)	
					Highest.	Lowest.
250,000l	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 —103	...	...
1,300,980l	Anglo-American Telegraph, Limited	Stock	48½— 49½	48½— 49½	48½	...
2,849,510l	Do. do. 6 p. c. Preferred	Stock	86 — 87	86½— 87½	87¼	86⅝
2,849,510l	Do. do. Deferred	Stock	12¼— 12¾	12 — 12½	12½	$12\frac{7}{16}$
130,000l	Brazilian Submarine Telegraph, Limited	10	10½— 11	10 — 10½	11	10
53,200l	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000l	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978l	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅜— 3⅝	3⅜— 3⅝	3⅝	3⅜
69,996l	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2⅛— 2⅜	2⅜	2⅛
50,000l	City and South London Railway, Nos. 1 to 50,000	10	3 — 5	3 — 5	3¼	...
$7,716,000	Commercial Cable, Capital Stock	$100	135 —140	140 —145	144½	139½
224,850l	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	$\frac{7}{16}$— $\frac{9}{16}$	$\frac{7}{16}$— $\frac{9}{16}$	½	...
20,000l	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	5 — 5½	5 — 5½	...	...
16,000l	Cuba Telegraph, Limited	10	10 — 11	10 — 11	10⅛	10
6,000l	Do. do. 10 p. c. Preference	10	17 — 18	16 — 17	...	...
12,931l	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3 — 3½	3 — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	9½— 10½	9½— 10½	$10\frac{13}{16}$	...
60,710	Direct United States Cable, Limited, 1877	20	10¾— 11	10¾— 11	11	$10\frac{13}{16}$
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14 — 14¼	13⅞— 14⅛	$14\frac{13}{16}$	14
70,000	Do. 6 p. c. Preference	10	15 — 15½	14¾— 15¼	15⅜	15
200,000l	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	107	...
1,200,000l	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 — 109	106 — 109	106½	106
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅞— 15⅛	14¾— 15	15⅛	14⅞
78,300l	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	103 —106	104 —107	...	...
276,200l	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	104 —107	...	...
320,000l	Do. 4 p. c. Debenture Stock	Stock	106 —109	106 —109	107¼	105½
135,000l	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	...	...
180,400l	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
201,600l	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	98 —101	100⅝	100½
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6¾— 7¼	6¾— 7¼	$7\frac{3}{16}$	$6\frac{15}{16}$
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅜— 2⅝	1⅞— 2⅛	2⅝	$1\frac{13}{16}$
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3 — 3¼	2⅞— 3⅛	3½	2⅞
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd,	2	1⅝— 1⅞	1⅝— 1⅞	$1\frac{15}{16}$	1¾
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅝— 9⅞	9⅝— 9⅞	9⅞	$9\frac{11}{16}$
180,042	Do. do. 6 p. c. Preference	10	14¾— 15	14⅝— 14⅞	$14\frac{15}{16}$	14⅝
150,000	Great Northern Tel. Company of Copenhagen	10	18¼— 18¾	18¼— 18¾	18¾	18¼
220,000l	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
12,134l	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	8 — 8½	8 — 8½	...	...
9,600l	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	20½— 21½	20½— 21½	21¾	20½
200,000l	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	42	41
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	6 — 7	6 — 7	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8¾— 9¼	8¾— 9¼	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7xd	6 — 7 xd	6	...
100,000l	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	107¼	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	10 — 10½	10 — 10½	10⅜	10¼
447,234l	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 4⅝	4⅜— 4⅝	$4\frac{9}{16}$	$4\frac{7}{16}$
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13	12½— 13	13	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 13	12 — 13	...	...
420,000l	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	106 —108	106 —108	107¾	107½
6,318l	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	6 — 7	6 — 7	...	...
220,000l	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	$\frac{3}{16}$— $\frac{5}{16}$	$\frac{3}{16}$ — $\frac{5}{16}$	...	...
9,000l	Reuter's Limited	8	7¾— 8¼	7¾— 8¼	7¾	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8¾— 9¼	8¾— 9¼	9¼	$8\frac{13}{16}$
7,900	Do. do. do. 7 per cent. pref.	2	7¼— 7¾	7¼— 7¾	$7\frac{9}{16}$	$7\frac{7}{16}$
3,381	Submarine Cables Trust	Cert.	118 —123	117 —122	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	4½— 5	4¼— 4¾	4⅞	4½
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43½	42¼
150,000l	Do. do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	1 — 2	1 — 2	...	...
146,370l	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
3,200l	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7½— 8½	7½— 8½	3	2¾
271,400l	Do. do. do. 5 p. c. Debentures	100	97 — 100	96 — 99	98	97
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2½— 3½	3	2¾
150,000l	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	97 —102	97 — 102	...	...
67,007l	Western and Brazilian Telegraph, Limited	15	10¼— 10¾	9¾— 10¼	10⅝	10
30,364l	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6¼— 6¾	6⅞	$6\frac{11}{16}$
30,364l	Do. do. do. 5 p. c. Deferred	7½	4 — 4½	3½— 4	4¼	...
189,700l	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	104 —107	104 —107	...	...
237,200l	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅜— 1⅝	1½— 1¾	1¾	1⅝
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	8¾— 9¼	8¾— 9¼	9⅛	9
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	7½— 8½	7½— 8½	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122	118 —122	...	...
173,100l	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6⅛— 6⅜	6¼— 6½	$6\frac{7}{16}$	6⅛

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting Company, Ordinary Shares of £10 each, £4 paid, 4⅛—4⅜.—Electric and General Investment, Shares of £5, £1 paid, 2¾—3¼.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem. fully paid, 1—1¼.—Elmore's Priorities, 3⅞—4⅛.—European Sims-Edison Torpedo Company, shares of £20, fully paid, 20—20½.—Halifax and Bermuda Cable, 4½ per cent. bonds, 85—95.—House to House Company (£5 paid) 4½—5.—Liverpool Electric Supply, Shares of £5, £3 paid, 2¾—2⅞. Shares of £5 (fully paid), 4⅞—5⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 1⅞—2⅛.—Manchester, Edison and Swan Company, £9 (£1 paid), ½—⅝.—National Telephone Debentures, 2½—3 prem.—Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2⅛—2⅜.—£5 Preference, fully paid 3⅝—3⅞.—Debentures, 90—95.—Wards Electric Car, £10 paid, ¾—1.

BANK RATE OF DISCOUNT.—4 per cent. (October 29th, 1891).

THE DYNAMOS AT FRANKFORT EXHIBITION.

By W. B. ESSON.

VI.

Messrs. Kummer & Co. of Dresden, had a good show of dynamos, specially designed for ship-lighting. To this branch the firm has for some years paid great attention, and several examples of machines directly coupled to engines as well as driven by belt, were exhibited. In fig. 27 is shown one of Messrs. Kummer's two-pole, belt driven machines, giving at a speed of 950 revolutions per minute, 100 ampères and 65 volts. This machine has a single horseshoe magnet lying horizontally and cast in one with the bed-plate, being overhung from the yoke as shown. The poles are hollowed out so that lines of force enter the armature on three sides of its rectangular core, and to form one side of the polar cavity, extension pieces are screwed on to the front of the magnet limbs. The construction of the armature is shown in the section, fig. 28. It is necessary, in order to avoid heating, that the core be divided in planes parallel to the direction of the lines of force entering it, so in the present instance the division has to be in two planes at right angles to each other. This is effected by building the core partly of iron washers and partly of iron band, the whole being supported by a stiff foundation ring, and attached to a suitable driving centre. The core so formed is Gramme wound in the usual way, and the general construction of the machine is well shown by the engravings.

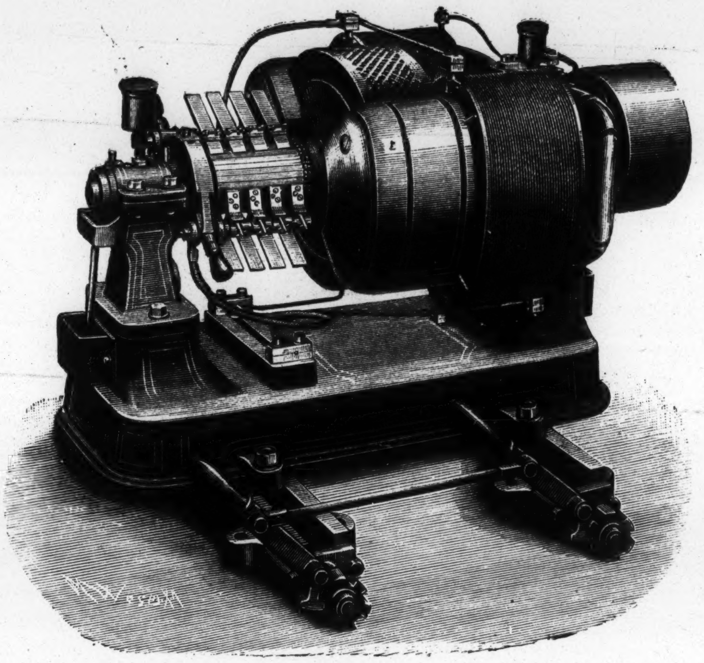


Fig. 27.

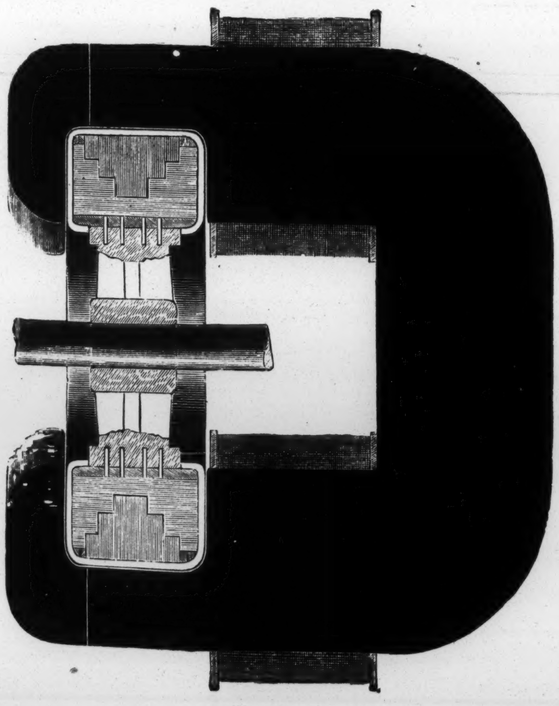


Fig 28.

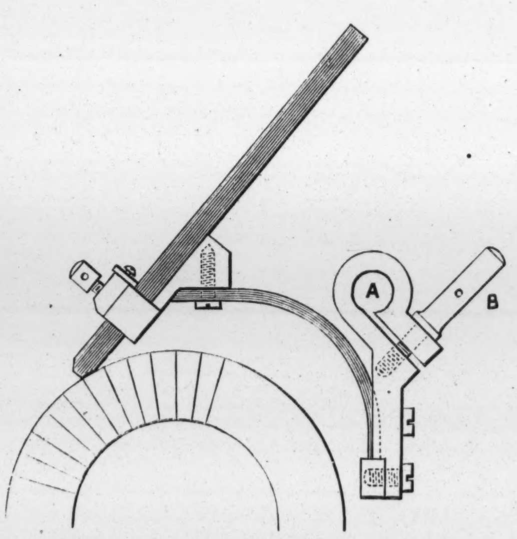


Fig. 33.

But machines of the four-pole class are the speciality of Messrs. Kummer, and in fig. 29 is shown one of their latest designed for belt driving. The machine is compound wound, and at a speed of 775 revolutions per minute, gives a current of 110 ampères at a difference of potentials of 120 volts.

The armature is Gramme wound and of usual construction, the core being formed of iron washers, insulated from each other, and having several spaces left along the surface for ventilation. It is wound with 400 convolutions of wire, connected up by screws to a commutator having 80 segments, and the current is collected by four sets of brass wire brushes, two in a set. The four radial magnet cores are cast in one with the circular yoke frame and bed-plate, there being screwed on each an extended pole shoe, visible in the figure. The armature is carried by a pair of cast iron bridge brackets, one of which is shown, the other, as well as the driving pulley, being in fig. 29, concealed.

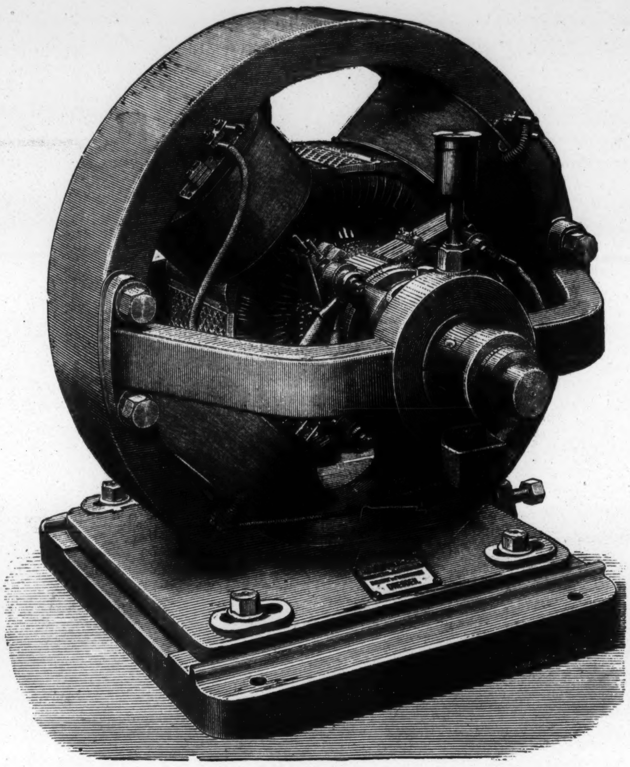


FIG. 29.

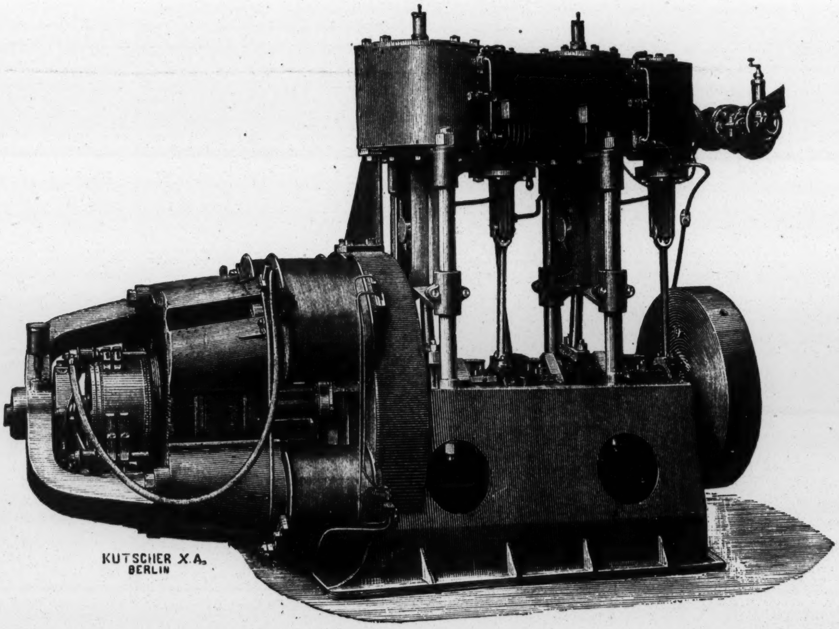


FIG. 30.

For the direct driven machines a different form of field magnets is adopted, as will be seen from fig. 30, which shows the largest dynamo exhibited. This machine is driven by a compound engine at a speed of 400 revolutions per minute, and gives a current of 330 ampères at 120 volts. The armature is 63 cm. diameter, and is Gramme wound, with 320 turns of wire connected up to a commutator with 160 segments. The four magnet cores are cast in one with the engine bedplate, the yoke being formed by a heavy circular block at one end of the latter. To these magnet cores are attached by steel screws pole pieces tapered towards the end, as shown. A cast iron bridge bracket lying diagonally and attached to two of the pole pieces carries the outside bearing. The engine cylinders are 24 cm. and 38·5 cm. diameter respectively, and both are steam jacketed. The stroke is 22·5 cm., and the piston speed, therefore, 3 metres per second. The engine is designed to work with a pressure of eight atmospheres, and when normally loaded both cylinders do about equal work. The cylinders are cast in one with the slide jackets, and the superstructure is supported by four wrought iron columns, which are tied together in pairs by the castings forming the double crosshead slides. The engine proper has four bearings and the dynamo one. The low pressure eccentric is keyed on the shaft between the two cylinders, while the high pressure one is influenced directly by a governor cased in on the right hand end of the shaft, and said to control the speed very effectively. Engines and dynamos of this pattern have been supplied to several of the large German shipping firms, and the combination is not only of novel design, but seems to work very efficiently.

Fig. 31 shows a similar arrangement, but with some modifications in the construction of the engine and difference in the dynamo details. It takes precedence of the combination in fig. 30 as regards date of design, and is the type used by the Imperial German navy, the output for all the machines on their ships of war being 12,000 watts at a speed of 450 revolutions per minute. In fig. 32 a small single cylinder engine is seen coupled to a small four-pole machine giving 34 ampères and 67 volts at 500 revolutions per minute.

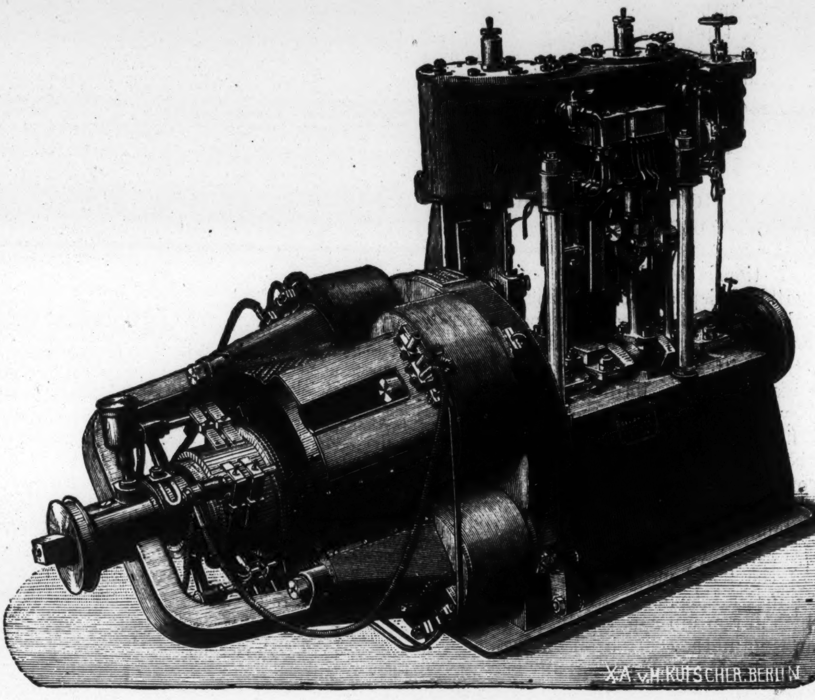

X.A. v. H. KUTSCHER. BERLIN.

FIG. 31.

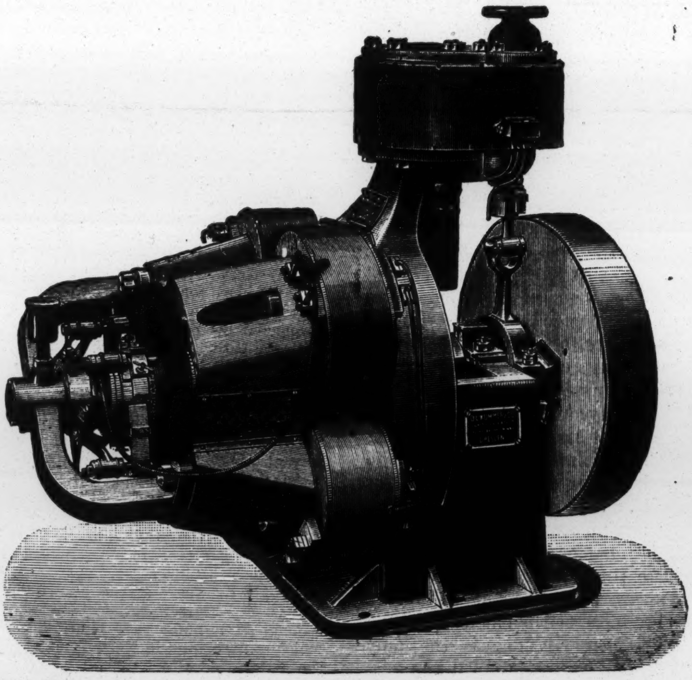


FIG. 32.

The brush carrier used for all their machines by Messrs.

Kummer is shown in fig. 33. The holder, clamping the brush, is fastened to a spring band consisting of a number of strips of hard drawn copper laid together, and bent to angle of 90°, as shown. The other end of the band is secured to a casting which is drilled and mounted on the usual pole pin, A. The pressure of the brush on the commutator can be readily adjusted by lifting or lowering the handle, B, and a saw cut being made into the pin hole, a turn of the handle serves to clamp the thing tightly in position. Several forms of this type of holder were to be seen in the Exhibition. Messrs. Siemens and Halske use one somewhat similar for all their machines, so does Fein.

(*To be continued.*)

PORTABLE TELEPHONE FOR FIRE BRIGADES.

A SHORT time ago, the National Telephone Company made up a special form of portable telephone for fire brigade purposes, which can be taken to fires on the hose and ladder carriages. It is enclosed in a small neat box, and comprises a complete receiver, transmitter, and magneto call bell. This instrument has recently been introduced into the Glasgow Fire Brigade by Captain Paterson, the chief.

When an alarm of fire is received, it is the first duty of the man in charge of the watch-room to switch the wire, over which the signal has come, on to the permanent telephone in the station, and the connection is then ready for being spoken on by means of the portable telephone from the street fire alarm in the vicinity of the fire. This is done simultaneously, and the disconnection of the telephone resets the fire alarm when no longer required for the telephone. A code of signals is also arranged by which any member of the brigade, with portable telephones, can ring up the central station from any of the street fire-alarms in the city, and transmit any message which may be necessary.. When the brigade turns out, one or more of these portable telephones is taken on the engine, and on arrival at the fire, the telephone is at once plugged on to the fire-alarm box nearest to the scene of operations, and speaking communication thereby at once established between the men at the fire and the brigade office with which the alarm is connected. It will thus be seen that in the event of a second alarm arriving at any of the fire stations, intimation of this can be sent instantaneously to the officer in charge of the fire, and in the event of more assistance being required at the second fire, this can be sent from the first fire when possible without the loss of time occupied by a messenger or the uncertainty there would be with any system of code rings by the ordinary fire alarm bell. In a word the portion of the brigade which is turned out, is as thoroughly in touch with the rest of the system, as if they were still in the fire station. In several cases the new instruments have proved of great service by the instantaneous transmission of a second alarm when a portion of the brigade was engaged at a fire. In the same way communication can be established from any of these street fire alarms through the central fire office or to the National Telephone Exchange system in Glasgow and to towns beyond. Conversations have been held from the street fire alarms in various parts of the city with centres as widely separated as Dundee and Kilmarnock, and found to be perfectly distinct. The telephones can also be used for tapping any telephone wire, either on a roof or found broken across the street (which often happens in case of fire) and for communicating, if it is an exchange connection, either to the fire brigade or to a private person. It is expected that this important addition to the fire brigade plant will prove most valuable, and considerably increase the efficiency of the members. It may be added that Glasgow is the only brigade in the kingdom which has as yet adopted the telephone for such a purpose.

Deptford Central Station.—We hear that a serious break-down has taken place in the mechanical arrangements of the Deptford central station. As we have said before, it is a great pity that the directors and Mr. Ferranti should have severed their connection before the station was in more thorough working order.

LEGAL.

ACTION AGAINST ELECTRICAL ENGINEERS.

(*Concluded from page* 573.)

ALEXANDER GOSKIRK said he was an electroplater and electrotyper at Norton Park, Edinburgh. The dynamo in question was brought to his place on October 8th this year. He connected it with his steam engine. He used it without a resistance coil or shunt. He connected it with the bath and put in moulds. He produced a perfectly satisfactory coating of copper. The time taken varied from 3½ to 4½ hours. His steam engine would be running at about 90 revolutions. The dynamo was doing from 700 to 850 revolutions. He got splendid work.

Cross-examined: Mr. Fairfoul, Mr. Rolfe and witness's foreman were present. One plate was 2 hours 58 minutes in the bath. The work was splendid electrotyping. The cause of failure to obtain good plates might be due to something being wrong with the bath, the moulds, the solution, or too little or too much power. If the solution in the bath did not agree with the electrical power the worker would make a mess of it. The density of the bath required to be kept up. Anyone who knew what he was doing always kept his bath saturated by hanging a bagful of sulphate in it, and the bath kept itself in condition by that means. In October last he had occasion to be at the office of the Brush Company and saw Mr. Browning, and mentioned the pursuers machine to him. He afterwards visited witness's works and saw the machine there. He stated no objection to the machine. Witness told him the revolutions were from 800 to 850. Mr. Browning said it had been run at 1,100 in the pursuer's works. Witness told him it could be reduced, and that he could tell by ocular inspection of the deposit whether the process was going on satisfactorily. He also told him that the pressure could be resisted if it was necessary to bring it down. On the second of this month he had a further test of the dynamo at his works. The dynamo was run at about 1,100 revolutions, and even up to 1,200. The work was first rate. The plates were in the bath from 1½ to 4 hours. There was no resistance coil used. The machine he considered would also do nickel-plating. He had a machine of the same kind, and he was doing all the work of the shop with it—brass, nickel, gold, silver, copper. He accounted for the pursuer's failure by want of density in the bath. The machine was throwing copper off his anodes into his bath—there was not enough of copper in the solution.

Three workmen, named REYNOLDS, LOCKHART, and GEMMELL, who had been in the pursuer's employment, stated that he had spent a great deal of time in endeavouring to get the machine to work. They knew the pursuer's customers complained about the delay in getting their work done.

GEORGE WILSON, traveller, said he often looked into the pursuer's shop. The pursuer, in the autumn of last year, was constantly complaining about the dynamo. He had to dismiss his men, as his custom fell off.

ROBERT SIMSON, ROBERT SANSON, and JOHN DONALDSON, printers, DAVID LISTER, foreman to Skinner & Co., and GEORGE TURNBULL, partner of Turnbull and Spiers, all printers in Edinburgh, stated that they had employed the pursuer as an electrotyper. At first he turned out very good work, but after getting the dynamo the work was badly finished, and there was great delay in executing it. In consequence of the delay and bad work, but principally the delay, they withdrew their custom from him.

This concluded the evidence for the pursuer.

The first witness for the defenders was ARCHIBALD FAIRFOUL, superintendent of the electrotyping department of the works of Thomas Nelson and Sons, printers and publishers, Edinburgh. He had had experience in producing electrotype plates, both by batteries and dynamos. In September last he was asked by Mr. Mountain to superintend a series of experiments for the purpose of testing the efficiency of a dynamo machine for the production of electro plates for printing. He suggested to Mr. Mountain that Goskirk's was a suitable place for the test. The first test took place on October 8th. At that time the dynamo was lying on the floor. Mr. Goskirk disconnected his own dynamo and connected the defender's dynamo with the bath. Mr Goskirk explained that the solution used in the bath was that with which he did his ordinary work. The dynamo ran from 800 to 850 revolutions per minute. One of the moulds put in the bath was there two hours and 58 minutes, and another three hours 15 minutes. The work produced was the best he had ever seen for so short a time. The force of the dynamo could be resisted in several ways. The anode could be kept away from the mould, or the resistance coil could be put into the shunt of the machine. If the bath was placed away from the dynamo, that also acted as resistance, or the bath might be enlarged and more plates put in. He also attended at the tests at Mr. Goskirk's on November 2nd. For the purpose of increasing the speed of the dynamo a smaller pulley was put on. There was no resistance coil. The dynamo was run at 1,100, and even to 1,200 revolutions. The plates were very satisfactory. The moulds were in the bath from 2 hours 56 minutes to 3 hours 20 minutes. The Weston dynamo, which witness used in Nelson's works, took about 5 hours to produce the plates. A battery took about 12 hours. A battery required acid, but no acid was required for the dynamo. Acid would burn the copper. He had seen the plates Mr. Denby produced; they bore evidence that there was too much acid in the bath, and that the solution was wrong. Witness's solution consisted of sulphate of copper saturated with water. When he used the battery he put in sulphuric acid. The strong current of the dynamo would cause a bad deposit if acid were used. If Mr. Denby took 14 hours in getting a deposit with his dynamo the delay would be due to the want of knowledge as to the density of his bath. If the dynamo was worked at 1,100 revolutions per minute it would produce excellent work in three hours and a-half. It was the best dynamo he had ever come across, and he had never seen better work.

Cross-examined: He had never had experience of a dynamo working 1,200 revolutions except at Mr. Goskirk's.

Mr. McKay, of Messrs. Robert Chambers and Sons, printers and publishers, Edinburgh, who was present at the experiments at Mr. Goskirk's, gave corroborative evidence. The quality of the work, he said, was first-rate, and it was done in a remarkably short time. He had now got the dynamo working in the office of Messrs. Chambers. On the previous night they made some experiments with it. The plates were in the bath 4 hours and 40 minutes while the dynamo was revolving from 1,000 to 1,100 times per minute, and excellent work was produced. He had never seen better work. He considered that with a flywheel of 4 feet, giving 160 revolutions per minute, and a 7-inch pulley, the dynamo with a 1,000 to 1,100 revolutions per minute ought to have done good work in the pursuer's shop.

Edward Lowes, foreman in the employment of the defenders, said he was in charge of their exhibits at the Edinburgh Exhibition in 1890. Witness was an electrical engineer, but he had no training as an electrotyper. On June 14th, 1890, Mr. Denby spoke to him about a dynamo for electrotyping. Witness sent instructions to Newcastle about the matter, and a machine was sent to Mr. Denby. In September he went to the pursuer's shop, and saw the machine, which was working very steadily. On a second visit he took a voltmeter with him, and found the machine working about 2 volts. They adjusted the engine and got about 1½ volts between the terminals. The pursuer put some plates into the bath and witness saw them next day. The pursuer said the body of the plate was very fair, but the top was a little granulated, but he had no doubt he would get over that. He made no objection to the dynamo. Until November 10th witness had no communication with the pursuer. On November 11th witness took a resistance coil and a voltmeter to the pursuer's shop. He fixed the resistance coil in the shunt. The dynamo seemed to be running properly. He looked at the bath; it seemed to be very pale, and he could see the plates in it by applying a light. He tested the solution and thought it was very weak. He said so to Mr. Denby, and advised him to strengthen his solution. There was some sulphate of copper put in that day. Witness gave him some particulars of a solution he had got. Some plates were put in for a couple of hours. On examining them witness thought everything was right, and he wrote the defenders to that effect. The next day he called again and saw the plates. They seemed to be very fair. Mr. Denby expressed his approval of them. Witness left the resistance coil with Mr. Denby. He met Mr. Denby again at Newcastle on December 10th, when Mr. Mountain proposed to send Mr. Rolfe, the manager, down to Edinburgh to test the machine if Mr. Denby paid his third-class fare. Mr. Denby took a voltmeter with him, and said he would try to manage the thing himself. In February last witness was in Greenock fixing a dynamo, and he got instructions to go to Mr. Denby's on his way back to Newcastle. Witness was to stay until Mr. Denby was satisfied. The dynamo was running all right, but the deposit was thin. The bath was the same as Mr. Denby had used before with the battery. Witness pointed out to Mr. Denby a solution the defenders had given him in writing, and said that he should make a solution of that kind and make a further test. Mr. Denby objected. He gave a general reason that he had been humbugged sufficiently, and was not going to be bothered any further. From its appearance he considered the dynamo had been very little used.

Cross-examined: He knew nothing about electrotyping, and saw a bath for electrotyping for the first time when he went to Mr. Denby's place. Witness never suggested that Mr. Denby wanted a machine for nickel-plating. One for electroplating required to develop more electromotive force than for copper depositing. The resistance required to be reduced for copper depositing. On his third visit the speed of the dynamo was about 1,100 revolutions per minute, and witness suggested to the pursuer to try less. The voltage would be about 1·9 for 2 volts. It was reduced to 1·3. The resistance coil did not reduce the pressure more than two or three points.

William Charles Mountain said that on June 16th, 1890, he received a letter from Mr. Lowes, stating that Mr. Denby wanted a small plating dynamo. Witness communicated with Mr. Denby, and supplied him with a dynamo. No objection was taken to the machine. They supplied a pulley of seven inches, and with a flywheel on the gas engine with 160 revolutions he calculated the speed of the dynamo would be 1,097 revolutions. Taking off 10 per cent. for friction, there would be left 988 revolutions. He calculated that the electromotive force of the dynamo with those attachments would be 2 volts. It was understood that, in working, an electrotyper required sometimes a larger and sometimes a smaller voltage. The witness described various methods for reducing the electromotive force. In supplying the dynamo to the pursuer they had no information as to the extent of his work or the size of his bath. They supplied an ordinary dynamo of a speed, so far as they could gather, suited to his requirements. All the dynamos which they supplied in class 6 were susceptible either for copper plating or nickel plating. To get the different work only required variation in the speed of the machine. The machine was sent on September 18th, and they had no complaint until November 6th. They had a correspondence with the pursuer in which they suggested the application of a resistance coil. They instructed their representative in Edinburgh to go to Mr. Denby with one. They suggested a resistance coil because from the letter Mr. Denby wrote he seemed to be running the machine harder than he should run it. They also lent him a voltmeter to guide him in remedying his machine. The pursuer came to Newcastle on December 10th, bringing some specimens of his work with him. The impression witness formed was that the pursuer must be attempting to deposit much faster than he possibly could do, and that his gas engine must be running too fast. Witness suggested a reduction of the speed of the engine. He proposed to send their chief electrical assistant, Mr. Rolfe, to see the machine if pursuer would pay third-class travelling expenses, but the pursuer would not accept that offer, and said he would try himself to get the machine to work. He took a voltmeter with him. Mr. Lowes afterwards went to see the machine, but the pursuer continued to be dissatisfied, and threatened to sell it by warrant of the sheriff if it was not removed. After its removal it was sent to Mr. Goskirk's, and afterwards to Messrs. Chambers. There had been no change made upon it. That morning he tested the voltage of the dynamo by a voltmeter. The dynamo was running at 1,020 revolutions by the steam engine. He found the voltage to be 1·65 at the terminals of the machine, and between the anode and the cathode it was, approximately, three-fourths of a volt. If the pursuer's gas engine flywheel was 4 feet in diameter, and the number of revolutions 160, the maximum speed of the dynamo, allowing for friction, would be about 988 revolutions.

This concluded the evidence, and the case was continued for a few days for the hearing of counsel.

NEW PATENTS—1891.

18,854. "Improvements in the construction of electrically controlled arc lamps." F. T. Schmidt. Dated November 2nd.

18,855. "Improvements in dynamos and electric motors." W. S. Freeman. Dated November 2nd.

18,857. "Improvements in meters for measuring electricity." E. H. P. Humphreys. Dated November 2nd.

18,890. "Improvements in rotary phase current motors and dynamos." Siemens Bros. & Company, Limited. Dated November 2nd.

18,897. "Improvements in methods of apparatus for regulating the supply of electricity used for lighting, motive power, or other purposes." R. Wood. Dated November 2nd.

18,898. "Improved insulating and protecting devices for concentric electric mains." W. F. Taylor and G. J. Philpott. Dated November 2nd.

18,899. "Improvements in electric meters." W. F. Taylor and G. J. Philpott. Dated November 2nd.

18,902. "Improvements in the manufacture of tubular conduits for electric conductors." G. F. Redfern. (Communicated by S. Bergmann, Germany.) Dated November 2nd. (*Complete.*)

18,905. "Improvements in electric railway signals, part of which are applicable to other signalling or alarm purposes." J. O. y Espinosa. Dated November 2nd.

18,916. "Trollies for electric cars." R. D. Nuttall. Dated November 3rd. (*Complete.*)

18,928. "Improvements in the application of electricity to various useful purposes." E. R. Dale. Dated November 3rd.

18,931. "Improvements in apparatus and process for obtaining aluminium or other metals by means of electricity." J. Pullman and H. Lane. Dated November 3rd.

18,938. "Process for producing filaments for incandescent lamps." R. Langhans. Dated November 3rd.

18,974. "Improvements in electrical furnaces for the manufacture of phosphorus or other matters capable of being volatilised by heat." T. Parker. Dated November 3rd.

18,976. "Improvements in arc electric lamps." T. Parker and E. S. G. Rees. Dated November 3rd.

19,020. "Improvements in telephonic switching apparatus." A. R. Bennett. Dated November 4th.

19,056. "Improvements in reflectors and appurtenances used in electric light photography." H. V. Weyde. Dated November 4th.

19,071. "Improvements in the manufacture of wires for incandescent lamps, and in connecting the said wires to the filaments." R. Langhans. Dated November 4th.

19,134. "Improvements in or relating to electric meters." F. Teague. Dated November 5th.

19,162. "Electric meter." A. M. Thompson and W. W. G. Webb. Dated November 6th.

19,176. "Improvements in rotating magnetic fields, and in multiphase alternating currents." E. A. Wahlstrom. Dated November 6th.

19,190. "A multiple terminal for electrical distribution." E. W. Watling. Dated November 6th.

19,198. "Improvements in apparatus for placing electric lamps in circuit in any desired order or sequence." A. G. New. Dated November 6th.

19,211. "Improvements in or relating to electric meters." F. Teague and E. F. Moy. November 6th.

19,225. "A polarised electrical indicator." Siemens Bros. and Company, Limited, and A. S. Schloemer. Dated November 6th.

19,233. "Improvements in and relating to electric railways." J. F. Munsie. Dated November 6th. (*Complete.*)

19,314. "Improvements in and relating to incandescent electric lamps." H. H. Lake. (Communicated by La Société dite Electriciteits Maatschappij System de Khotinsky, Germany.) Dated November 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

11,263. "Improvements in wall sockets for temporary electric connections." J. M. M. MUNRO. Dated July 19th. 6d. The wall socket consists of two parts, the socket proper and the plug which fits into it, and to which is attached the conductors, usually flexible, which carry the current to a portable lamp, or for other use. The socket has a round orifice with two slots in its sides, so made that any capped glow lamp, such as those now made by the Edison-Swan Company, Limited, will fit into it, and flexible contact springs (one for the positive end of branch lead and the other for negative end), are so placed within it that when such a glow lamp is pushed into the socket the lamp will incandesce if the wires joined to the socket are connected with a suitable dynamo or battery circuit. A side spring is set so as to fall into a notch (which must be made in the brass caps of lamps) when the lamp is home and therefore making good contact. There is no bayonet movement, as in most lampholders. 1 claim.

12,713. "Improvements in electric mains and in apparatus used in their manufacture." S. Z. DE FERRANTI. Dated August 13th. 8d. In order to facilitate the winding of paper or fabric which has been saturated with paraffin or other insulating material around each length of conductor to insulate it, as described in Patent No. 16,237 in 1889, the inventor employs a pair of horizontal parallel rollers on whiich to support the conductor as the paper is being wound around it, and cause the conductor to be pressed down on to the supporting rollers by a weighted roller. In order to avoid putting strain upon the paper as it is being wound around the conductor, he causes the conductor to be revolved by gearing at its ends, and also causes the supporting rollers to be driven nearly up to the same surface speed as that of the paper, which is being wound on to the conductor, so that there may be but little rubbing of the paper against the surface of the supporting rollers; the upper roller might also be driven if desired. 9 claims.

13,845. "Improvements in and relating to the propulsion of tramway vehicles or boats by means of electricity." J. L. HUBER and L. J. MAGEE. Dated September 3rd. 8d. Consists in storing the surplus electricity supplied to the motor with convenient tension from the main circuit in a number of secondary batteries arranged in the car or cars at that part of the journey during which contact may be made with the conductors of the main current, thereby using preferably the accumulators as regulators instead of rheostats, and then employing the electricity thus stored on those parts of the journey where no contact with said conductors is possible or convenient. 2 claims.

13,921. "Improvements in electric lamps." A. SCHANSCHIEFF and K. SANDO. Dated September 4th. 6d. Consists in placing a refractory material, preferably unglazed china, close to the carbon of the lamps. 2 claims.

13,987. "An electricity counter." J. RICHARD, F. RICHARD, and G. RICHARD. Dated September 5th. 8d. Consists of a spring clockwork arrangement which is kept wound up by the action at intervals of the current on an electro-magnet; secondly, of a wattmeter, which by means of the clockwork is at certain intervals brought into circuit with the electric conductors to which the instrument is applied; and, thirdly, of a totaliser which sums up and shows by indices on dials the watts of energy indicated by the wattmeter at the successive periods when it is put in circuit. 3 claims.

CORRESPONDENCE.

Schuckert's Two Phase Dynamos.

The methods employed in this machine to obtain alternating currents from a continuous current armature having an ordinary commutator, are quite similar to the methods employed by me early in 1886, and described in my provisional specification, No. 12,531, October 2nd, 1886.

Connections were taken from the continuous current armature at opposite diameters and connected to insulated rings on the shaft from which alternating currents were obtained. There being no immediate demand for such machines at that date I allowed the subject to drop.

The ingenious method of Schuckert whereby the machine is used as a two phase motor, is a very important improvement, and so far as I know perfectly novel; it works very nicely on my duplex system.

Rankin Kennedy.

November 13*th*, 1891.

Electric Tricycle.

I am desirous of driving a tricycle by electric power, and should be glad of any information on the subject you or your readers can give. (1) Can a strong accumulator be provided of about $\frac{1}{2}$ cwt. or less to drive a tricycle and rider 5 to 10 miles? (2) Cannot the motion of the axles of the tricycle be utilised to generate further power, when the tricycle is going, to aid in propelling the tricycle?

Wheels.

November 14*th*, 1891.

The Magnetic (?) Lady.

As many of your readers may not have seen my letter in the *Times*, they may be interested to know that, at any rate, the above performance is a perfectly genuine one, no assistance whatever being given to the lady, and her force is distinctly self-contained.

I am by no means a stranger to the Alhambra stage, and I think that if it had been any question of stage trickery the directors would hardly have asked me, at any rate, to have gone on the committee.

From the earlier tests I was at first inclined to believe that it was only some process of hypnotic suggestion, and as I do not approve of mesmerising performances, I took no active part in withstanding the lady's prowess. The subsequent tests, however, were of a totally different order, as the force exerted in many instances must have been enormous, and as I had hold of the lady's fleshy, but not muscular, arm on several occasions, I can safely say that muscular power was not brought into play, the biceps remaining quite supple.

To me the most interesting experiments were those in which the force was not exerted direct on the object, and on as many occasions as I could I placed my palm between Miss Abbott's hand and the chair or cue. The lady did not touch the object except through my hand, and although I kept this motionless I endeavoured to exert an active influence the reverse direction of what was desired. On the occasion when she moved off the ground the two chairs with six heavy men on them, and when from the great trembling of her arms some great force must have been brought into play (although her muscles were inert), I felt a vibratory agitation through my hand somewhat similar to what I have on certain occasions experienced when near a powerful dynamo.

Surprise has been expressed that the billiard cue did not break when three or four men were pushing against it, but I would point out that objection was taken to anyone placing their two hands side by side, as the lady did not appear able to exert any power against the particular "circuit" thus formed by one body. By thus distributing the hands the strain was not so much at the ends of the cue and the force and weight were more spread over the centre of it; however, on the occasion of the four men attempting to force back the cue it bent to almost breaking point.

Unless one has been so intimately associated with the performance as I was it is quite impossible to understand the profound impression it produces, and certainly the whole exhibition is of far greater scientific and general interest than any of the objectionable mesmerism entertainments that have recently become so frequent.

I believe it is intended on every occasion to have gentlemen from the audience on the stage, and I am sure the management would give a preference to any electrical engineer at all well known who desires to have an opportunity of thus closely watching the performance.

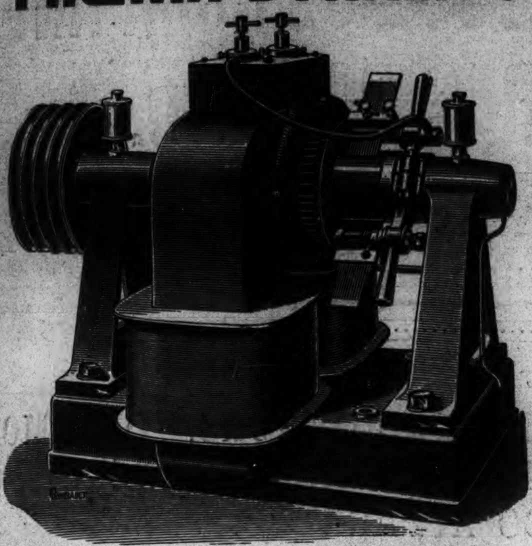
John B. Verity.

November 17*th*, 1891.

ERRATUM.—We regret that in quoting from Mr. Bennett's paper we inadvertently printed on p. 560 of our issue of November 13th, first paragraph, "$5\frac{1}{4}$ square inches" instead of "$5\frac{1}{4}$ inches square." The correction affects the comparisons on lines 7 and 14. As printed in our article, these do not represent the comparison in Mr. Bennett's paper, which was "9·9 square feet" and "$5\frac{1}{4}$ inches square." The purport of the paragraph is not otherwise affected, as our statements and comparisons are correctly based on inches square, and not square inches as printed in error.

MR. A. R. BENNETT.—The correspondence is closed. We thank you for calling our attention to the error, which we have corrected.

PHŒNIX DYNAMOS



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ELECTRIC LIGHT & TELEPHONE APPARATUS
OF EVERY DESCRIPTION.

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WRITE FOR PRICE LISTS 203

PHŒNIX DIRECT CURRENT DYNAMOS.

"S" TYPE. MODERATE SPEED.

Size.	OUTPUT IN WATTS.	Difference of Potentials in Volts.	No. of 60 Watt Lamps.	Approx. Speed.	Approx. Horse Power.	PRICE.	Extra for Bedding Rails and Tightening Screws.		Extra for Fly Wheel for Gas Engine.	
						£	£	s.	£	s.
1 S	600	30 to 60	10	1,800	1	20	1	10	2	0
2 S	900	40 to 70	15	1,750	1½	24	2	0	2	10
3 S	1,200	50 to 80	20	1,700	2	28	2	10	3	0
4 S	2,100	50 to 110	35	1,600	3½	38	3	0	3	10
5 S	3,000	60 to 110	50	1,520	5	44	3	5	4	0
6 S	4,500	60 to 110	75	1,480	7½	55	3	15	4	10
7 S	6,000	60 to 120	100	1,360	10	65	4	5	5	0
8 S	9,000	60 to 120	150	1,260	15	85	5	0	5	10
9 S	12,000	60 to 120	200	1,180	20	105	6	0	6	0
9½S	15,000	80 to 150	250	1,100	25	120	7	0	—	
10 S	18,000	80 to 150	300	1,020	30	135	8	0	—	
10½S	21,000	80 to 180	350	1,000	35	155	9	0	—	
11 S	24,000	80 to 180	400	900	40	175	10	0	—	
12 S	30,000	100 to 200	500	800	50	200	12	0	—	

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8D	18,000	65 to 110	300	650	30	170	8	0
9D	24,000	65 to 110	400	600	40	220	10	0
10D	36,000	110 to 125	600	500	60	290	12	0
11D	48,000	110 to 125	800	450	80	375	14	0
12D	60,000	110 to 125	1,000	400	100	450	16	0

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Printed by E. KNIGHT, 18 and 19, Middle Street, E.C., and Published by the Proprietors, H. ALABASTER, GATEHOUSE & Co., at 22, Paternoster Row London